THE

ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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	Page
Capital and Labour...	741
Wireless Telegraphy (*illus.*)	744
Electric Power and Supply Bills and Smoke Nuisance ...	746
A Time Meter for Tramcars	747
Extra-High-Pressure Regulations of the Board of Trade ...	748
New Electrical Devices, Fittings and Plant (*illus.*)	749
Legal	750
Correspondence	751
Business Notes	753
The Dundee, Broughty Ferry and District Tramways (*illus.*)	761
Electricity Supply in Stoke Newington (*illus.*)	763
City Notes	768
Electric Tramway and Railway Traffic Returns	772
Stocks and Shares	772
Share List of Electrical Companies	773
Parliamentary	775
Proceedings of Institutions:—	
Economic Considerations in the Employment of Storage Batteries	780
Radiation of Electric Waves Mainly Confined to Certain Directions (*illus.*)	782
Tramcar Equipment	783
New Patents Applied For	784
Published Specifications	784

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CAPITAL AND LABOUR.

WHATEVER may be the terms of the measure, there is now but little doubt that before the close of the present session, another Act, dealing closely with the relations of Capital and Labour, will have been placed upon the Statute Book. We refer, of course, to the Trades Disputes Bill, which has had its second reading. Howsoever it may be modified, either in committee of the House of Commons or in the House of Lords, there is no room for doubt that it was conceived in, and must eventually to some extent promote, the interests of organised labour. Indeed, if one may judge by the opinions of those who at all times espouse the cause of the trade unions, it is to be regarded as a charter of freedom for these bodies, without which they are destined to be powerless in the future.

It is not uninteresting to consider, as calmly and dispassionately as possible, whether class legislation of this kind is in the real and permanent interest of those whom it is intended to benefit. To judge from the Statute Book, it would appear that no Government in recent years has hesitated to adopt measures of reform on the ground that they may increase the cost of output, or tie the hands of employers. The Factory Acts, the Coal Mines Regulation Acts, the Truck Acts, and the Workmen's Compensation Acts—not to mention a large number of clauses in other Acts, like those dealing with Public Health—all these measures were for the avowed object of improving the condition of labour. No doubt some few of them, and in particular those which safeguarded the health of the worker, are of some incidental benefit to the employer, inasmuch as healthy surroundings conduce to better workmanship. But has all this legislation made the working man more content, brought him more work, increased the comfort of his life, or enabled him to make better provision for the day when he shall be past his work? We need not go far to find an answer to these questions. The cry is still for the grant of larger powers to trades unions, so that the working man may improve his position and earn an increased wage; there is great lack of employment in certain industries; and so far from better conditions having conduced to thrift and provision for old age, the workhouses are crowded, and the moral certainty that he can at some time obtain relief from the rates appears to justify many a working man spending a comparatively thriftless life. The answers to the questions which we have propounded are the more remarkable, when it is remembered that for many years not only has elementary education been free, but facilities for the higher and technical education of the children have also been provided at the public expense.

Free education and higher wages have been conceded within the last few decades; yet the representatives of Labour, whether in the House of Commons or in the

country at large, are not satisfied. One is thus tempted to believe that the sinister utterance of a Socialist leader in Hyde Park, when he said that the working classes wanted *less* work and more wages, is somewhat near the mark.

Seeing that the reforms made by some of the statutes above enumerated have had but little effect, it is at least doubtful whether any further legislation in the same direction will be of any avail. The Labour Party has begun to appreciate its strength. Money which was formerly devoted to strikes, is now being expended in promoting the candidature and paying the expenses of Labour Members. It has been found that Labour as a voting machine is more powerful than Capital; but the representatives of Labour would do well to pause before they force legislation upon the country which, in its immediate consequences, may appear to them to be desirable, but the remoter consequences of which are completely left out of account. The Workmen's Compensation Act affords a good illustration of the disasters which may follow upon class legislation.

Workmen thought, when this Act was passed, that the millennium had come. Compensation was to be paid to them when injured; provision was to be made for their families if an accident should result in death; and inasmuch as the Act was of universal application, it was thought that there would be no reduction in wages, no change in the conditions of employment. But the attitude of the employer who had to pay was not fully considered. The advocates of this measure reckoned without their host. Finding that he is bound to pay compensation alike to young and old, hale and infirm, the employer naturally chooses those who are young or healthy rather than those who are old or likely to be more easily incapacitated. In the result, older men—men over 60—find it difficult to obtain employment in places where there is any element of danger, and are cast upon the friendly societies or the rates. Was this prospect before the eyes of those who clamoured for universal compensation? That the present Government realise this defect in the Workmen's Compensation Act of 1897 is evidenced by their having made provision, in the Amendment Bill which is now before the House, to enable older men to "contract out" of the Act of 1897.

What is the moral to be drawn from the above illustration? This brings us back to the Trades Disputes Bill now before Parliament. Total immunity from the consequences of all acts done in the course of a strike is prayed for. It is asked that trade union funds shall never be drawn upon to pay for damages resulting from inducing persons to commit breaches of contract, acts of violence and intimidation, or from the keeping of honest and would-be hard-working men out of employment. It would seem, indeed, that after the Bill now under discussion is passed, the non-unionist may wander about the streets with his family for the rest of his life without obtaining redress of any kind. Similarly, the employer may as well shut down his mill if he does not employ union workmen, or pay such wages as that imperious body shall dictate. We doubt not that it is to the free and unlicensed enjoyment of these powers that the less high-minded of the advocates and supporters of trade unionism are anxiously looking forward.

But what shall be the remoter consequences of this dangerous species of legislation? Let it be remembered that there are trades unions of employers just as there are unions of workmen; that there is no Act of Parliament to prevent an employer closing his works at home, and transferring his capital abroad; nor is there anything to prevent the importation of foreigners who, all unfettered by the rules of trade unions, and contemptuous of their coercion and intimidation, may supply the demand for labour. Granted that the importation of foreign labour is a remote possibility, there is no foretelling the expedients to which masters may not be compelled to have recourse. It is too often forgotten by the Labour Party that it is the man with the capital who generally has the last word in these matters. A hundred workmen may have skill, industry, and power of combination upon the lines laid down by trade unions; but unless they have a head to guide their labours, and capital to enable them to work along the proper lines, they can effect nothing.

Bearing these considerations in mind, the political economist will look forward with interest, the employers with alarm, to the changes which are proposed by the Trades Disputes Bill.

Submarine Bell Signalling.

A PAPER describing this system was read before the Society of Arts on Wednesday evening last week by Mr. J. B. Millet, who, for some years past, has been devoting his best energies to the matter. Sir William H. White, who presided, expressed his unqualified approval, and mentioned that so important is it as an aid to navigation, in thick weather, that owners of ships provided with the apparatus do not fail to mention the fact in their advertisements to attract passengers. All important lightships on the North American Coast are provided with the submarine bells; before long German lightships in the North Sea are to be similarly equipped, and our own Trinity House has recently made exhaustive experiments with, we are informed, most satisfactory results, and there is little doubt that this new method of communication will be largely adopted in the future, not only for the purpose of guiding ships in thick weather, but also for the passing of actual messages. There is nothing new about the system, and the discussion brought to light other workers who were in the field earlier than Mr. Millet, though not one of them appears to have appreciated the practical utility of the system. It seems that the vibrations of a bell weighing only a few pounds, but of somewhat peculiar design, when struck under water are easily and unmistakeably audible over distances of 10 or 12 miles with the help of a microphone placed in a tank of water joined to the skin of a ship below the water line and connected with telephone receivers placed in a convenient position on the bridge, while with proper tuning even 30 miles is within the bounds of possibility. Unlike air, water is a very reliable medium, and plays no tricks, so that it may be expected that it will be found more suitable for short-distance communication than any other medium—ether included.

While listening to the Paper it occurred to us that it would be very convenient if the buoys used by telegraph repairing ships could be provided with bells placed under water and struck automatically by some simple means. A ship fitted with the receiving apparatus, as arranged by Mr. Millet, would then be able to find the buoys without much difficulty in foggy weather and repairing operations in certain localities might be considerably facilitated.

Water-power in Norway.

AN explanation of the reasons which have induced the Norwegian Parliament hastily to pass a provisional law in regard to the control of the waterfalls in that country, which it was feared would be transferred to German and English companies, has been given by M. T. de Ditten, the Norwegian Minister in Berlin. It appears from the statements by him that the few rich people in Norway are not inclined to invest their money in industrial establishments. The wealth of the country lies in its mineral resources,

woods, and waterfalls, the latter of which often represent as much as 40,000 H.P. The owners of the waterfalls are unable to develop them owing to lack of funds, and the possibility of a considerable portion of them passing into foreign hands had to be reckoned with, but the Government deemed this to be undesirable. The Norwegian railways are almost exclusively State property, and the idea is entertained of introducing electric traction by the utilisation of the waterfalls in the country. If, however, the falls were transferred to foreign ownership, the execution of the railway conversion scheme would meet with difficulties. In order to prevent this a law has been brought into immediate operation which renders it possible for falls representing considerable power to pass into the possession only of companies whose share capital is held by Norwegians to the extent of at least one half, and whose directors are domiciled in Norway and are all natives of the country. The Minister states further that the action of Norway in this respect has been dictated by the experience gained in Sweden, where the Parliament adopted a law reserving to the State the right of utilising the large waterfalls existing in Sweden.

The Duties of a Traffic Superintendent.

A NEW manager has been appointed to the Aberdeen Corporation tramways, and he has lost no time in flourishing his broom. From reports in the current tramway journals it would appear that he wants to make a clean sweep of everything into his own lap; a laudable desire enough, but not always a wise one. We will not waste space by suggesting reasons why this particular manager would have been well advised in playing a more modest *rôle*, but they are real and cogent.

At Aberdeen it seems that the term "general manager" is somewhat of a misnomer, and we have doubts as to the correctness of our contemporaries in applying it in this connection, for the duties are little, if any, greater than are required of the "traffic manager" or "traffic superintendent" who, in the larger undertakings, is subordinate to the general manager.

Perhaps if that is understood at the outset, less surprise will be expressed at reading that very little of the clerical and accounting work is at present in the hands of the manager, while the work in the depôts is undertaken by the borough electrical engineer (Mr. Bell).

That being the position of affairs we are far from considering necessary any criticism of the Tramways Committee, who may be believed to have set out to govern the department in the way which they thought best, and to have advertised for and selected a man whom they considered capable of undertaking the limited duties of the position as defined by themselves.

We do, however, take particular exception to the manager's suggestion that as he has "to send the rolling stock to the Corporation workshops for examination and repair by and under the superintendence of the electrical engineer, he ought to have charge of the motor inspectors, whose duty it is to send cars to the electrical engineer for repairs, and who also train the motormen to the tramway manager's instructions."

So long as the engineer is responsible to the Committee for car repairs it is essential that he should know all about the health and treatment of the cars when they are not under repair, and he is the man with the special knowledge who alone can instruct the motor inspectors in their duties, and read and act on their reports with the highest intelligence.

One of the most important points to be observed wherever dual control is in force is that responsibility for any particular section of the work shall be split as little as possible, and it is easy to see that, if this be true, the inspectors of "motors" (meaning the whole car with its equipment) must be directly responsible to the repairer of motors, in this case the engineer.

Similarly we hold that the engineer, being the only official with the special knowledge required, is the man to train and supervise the teaching of the men who, in their turn, train the motormen who have the wear and tear of the cars so much in their hands; in fact, a strong case can be made out for putting the motormen themselves entirely under the engineer's control. In that case he would supply the traffic department not only with cars but with drivers for the cars, and by the aid of his "motor" inspectors he would be able to deal with offences and accidents in a more efficient and much more satisfactory manner than a purely "traffic manager" ever can do.

We hope to show one day that the most workable solution of the whole matter is single control by a general manager.

The Liability of Poor Law Guardians.

A CURIOUS case, which illustrates, incidentally, the inadvisability of Guardians allowing paupers under their care to act as assistants in the carrying out of electrical work, is reported at length in the current number of the *Law Reports*. It appears that the defendants, the Guardians of the Poor of the West Ham Union, were carrying out an enlargement of the electric light installation at their workhouse by means of their own servants, the work being done under the supervision of their engineer, a permanent official of the workhouse. The plaintiff, a pauper inmate of the workhouse, was ordered by the labour master to assist in the works, and was put to work on a staging some distance above the ground; while he was at work, the staging, for the safety of which the engineer was responsible, gave way owing to its negligent and improper construction, and the plaintiff was injured. In an action against the Guardians to recover damages for negligence, it was contended on the part of the Guardians that the accident had occurred owing to the negligence of a workman in the common employment of the plaintiff, and that by the well-known doctrine of the common law, the employers could not be held responsible.

The doctrine that a servant is to be deemed to take certain risks upon himself was thus clearly and crisply put by Lord Abinger in a well-known case: "The servant is not bound to risk his safety in the service of his master, and may, if he thinks fit, decline any service in which he reasonably apprehends injury to himself: and in most of the cases in which danger may be incurred, if not in all, he is just as likely to be acquainted with the probability and extent of it as the master." To this it was replied, not without reason, that the plaintiff was not in the position of an ordinary servant, inasmuch as he was working under compulsion. That is to say, as a pauper he was bound to do any work assigned to him by the labour master of the union. The County Court Judge found for the defendants, but he was reversed by the Divisional Court, the Chief Justice saying: "When a pauper goes into the workhouse he does not know what work he may be called upon to perform, and it seems to me an unjustifiable extension of the doctrine of common employment to say that for a man to go in a starving condition into the workhouse is equivalent to a contract on his part to do any work that he may be ordered to do as though he was a servant who could refuse to do it." In the event the plaintiff had judgment. There was another question discussed in this case, which is not without interest. It was urged that it would impose a heavy liability on Guardians to make them liable to a pauper inmate for the negligence of a servant in carrying out the duties of administration. It has been held that, if the injury arises from the negligence or omission of a subordinate to comply with his instructions, he being a proper person for the post which he was appointed to fill, no action will lie against a public body such as a Board of Guardians. It is impossible to contend that the Guardians ought to escape liability in a case of this kind, as the Chief Justice said: "Put shortly, the facts are that the defendants decided to extend the electric light installation in the workhouse; they did not engage a contractor for the work, but did it themselves by their own servants who, in the course of the work, erected this platform." If Guardians undertake the work of an electrical contractor they clearly ought to be subject to the risks to which a contractor is exposed.

WIRELESS TELEGRAPHY.

By REGINALD A. FESSENDEN.

Very little is known in Europe of the scientific work done in America, and consequently there is a good deal of repetition to the mutual disadvantage of workers on both sides of the Atlantic.

It may, therefore, be of interest if I give a brief description of some of the work done by me relative to the determination of laws governing the propagation of wireless disturbances, together with a little new matter which has not heretofore been published.

Wave Measurement.

A large number of receivers for electric waves were tested in the years 1896 and 1897, and a number of new ones invented.

In connection with receivers, some sensitive indicating instruments were also designed, one of these being the string galvanometer which was constructed for me, according to my designs, by Mr. John A. Brashear, the optical instrument maker, in 1896. This proved a quite satisfactory instrument, and has since come into use under the name of the Einthoven string galvanometer.

The earlier forms of receivers were abandoned in favour of the instrument which I have described elsewhere, consisting of a Boys' radio-micrometer having its thermo coupling heated by radiation from a heating coil. This proved fairly satisfactory, and the matter of putting it on the market was considered by Messrs. Queen & Co. about 1899, but this was never done, though the instrument was described at the 1899 meeting of the American Association for the Advancement of Science. I found that this instrument gave fairly satisfactory results in many ways, and the general usefulness of the instrument has been confirmed by Mr. Duddell.

This instrument was, however, abandoned in the spring of 1899 for the Elihu Thomson ring galvanometer, in which two coils generate inductively currents in a third coil or ring suspended at an angle of 45° to the first coils. This latter instrument proved much more suitable for quantitative work, especially in connection with resonance phenomena, as its ohmic resistance could be kept very low, and the coils were not in proximity to any iron.

With this instrument a large number of absolutely reliable quantitative measurements was made, and the laws of the propagation of the waves definitely determined.

It was found that the intensity fell off as the square of the distance up to distances of several miles, and that the waves were not true Hertzian waves as held by some, nor current waves spreading out at a uniform height, as held by Taylor, nor electrostatic impulses, one antenna forming one plate of the condenser, and the other antenna forming the other plate, as held by Blondel until after the publication of my results, but were a new type of waves, the existence of which was stated to be possible by Hertz, but the existence of which had not been demonstrated by him. This new type of wave was found to be different from the Hertzian waves in that Hertzian waves were propagated in a straight line, but these waves followed the surface of the conductor. It was found to differ from electric oscillations in wires in that while it followed the surface of the conductor, the electrostatic and electro-magnetic intensities were in phase instead of 90° apart.

This form of indicator was developed into a telegraphic receiver, but for scientific work it was abandoned in favour of the hot-wire barretter.

The hot-wire barretter consists of a minute platinum wire about ·00004 of an inch in diameter, and about ·01 of an inch long. Its specific heat was such that a fiftieth of an erg is sufficient to cause a change in resistance of 1 per cent.

This instrument possesses many advantages over other instruments for accurate scientific work. It introduces no self-induction or capacity into the circuit. It can be standardised so as to be absolutely quantitative in the same way as a platinum thermometer. It needs no adjustment. It does not affect the tuning of the circuit in any way. It can be given such a resistance that it absorbs all impulses irrespective of frequency. It can be buried in the ground or immersed in water so as to measure the intensity of the waves there, and possesses many other advantages.

With this instrument a great deal of work was done, more especially in determining the way in which the intensity of the waves falls off below the surface of water containing different percentages of salt, below the surface of different kinds of soil, and in determining the changes which take place in the electric oscillations where the waves have to make sudden changes of course, as in going up a bank from the water; in studying the way the waves are reflected; and by means of a step-ladder in measuring the way in which the waves increase in height in going out from a vertical antenna. It was also used largely in making experiments on tuning and in measuring wave lengths, and in detecting possible changes of wave lengths with distance.

With this receiver it was found that, when stations were constructed on the sea level close to the water's edge and provided with a wave-chute, up to 50 miles the energy received fell off directly as the square of the distance. These experiments were completed in 1901 and 1902.

In 1902 the liquid barretter was invented. This was found, when proper precautions were taken, to be a truly quantitative instrument, and by 1903 the correctness of this law, *i.e.*, that the intensity falls off as the square of the distance, was proved up to a distance of 250 miles.

Since that time further experiments have been made up to a distance of a little over 3,000 land miles, and it has been found that the law still holds.

Atmospheric Absorption.

The weakening of signals observed at different times is due, amongst other things, to two causes, one due to the fact that some receivers such as the coherer must be adjusted less sensitively when there is much atmospheric disturbance in the neighbourhood, the other due to an actual absorption of the energy.

Insulating an antenna or constructing it of such a size that there is no ionisation has no effect on these losses. Nor does the weather at either station have any effect on these losses, as the losses depend upon what is going on in the air *between stations*. It is true that Captain Wildman's experiments show that the loss varied with the condition of the weather at the stations, but this was doubtless due to the fact that the stations were close together, *i.e.*, only a little over 100 miles apart, so that the weather at the stations was the same as the weather between them.

In working across the Atlantic between Boston and Machrihanish, it is found that the intensities of the signals received by either station are identical on the same night. Out of a great many observations made during the last winter, on 96 per cent. of the tests the intensity received at Machrihanish from Boston were identical with the intensities received at Boston from Machrihanish. By identical is meant that the intensities agreed within 5 per cent. The difference which occurred on 4 per cent. of the tests was probably due to causes aside from atmospheric absorption.

This identity in the strength of the signals would not of itself prove that the effect obtained took place near or at the stations themselves. These results were, however, checked in the following way. In addition to the stations at Machrihanish and Boston, operators were stationed at the following points :—One of the company's cottages, Lynn, Schenectady, Philadelphia and Washington, the distances from the Boston station being, respectively, 200 yards, 30 miles, 170 miles, 270 miles and 400 miles. The Machrihanish station is distant 3,004 land miles from the Boston station.

The intensities were taken by measuring the intensities of certain signals which experiment had shown to be best adapted for giving quantitative results.

It will be seen from this that a wide range was covered, and the results of these experiments showed that the absorption did not take place at the stations. The amount of this absorption varies very greatly.

In making the comparison we will confine ourselves for the present strictly to measurements made at night, on account of the fact that the amount of sunlight will vary on different days during the daytime.

Taking the best night as standard, and it may be men-

tioned that in every case so far examined, the best night never exceeds the theoretical intensity, thereby showing that there is no *reflection*, the intensities on the worst nights were as follows for the following distances.

(By intensities on the worst nights is meant the intensities which may be expected to occur as often as three or four times a month. The fact may here be noted that these worst nights appear to be really worse nights, *i.e.*, not more than 1 per cent. of the total nights will be found to be worse than the worst nights. This would seem to indicate that on the so-called worst nights the absorbing body occupies almost the entire path of the waves between the stations.)

Station.	Distance.	Strength of signals received on worst nights (strength of unabsorbed signals being taken as 1,000).
Company's cottage ...	200 yards	1,000
Lynn	30 miles	1,000
Schenectady	170 miles	500
Philadelphia	270 miles	300
Washington	400 miles	150
Machrihanish	3,000 miles	1

It will be seen that the absorption increases as a high power of the distance, at least up to a certain distance. There is some indication that after a few thousand miles the rate of absorption becomes constant. For example, on certain nights there appeared to be indications at the Boston station of a double set of impulses being received, one about a fifth of a second later than the other. It is too early yet to make any definite statement in regard to this matter, but there is some reason for thinking that the second set of signals arrived at the station after going the longer way round.

To take an actual numerical example, the strength of signals received at Boston from Machrihanish on the night of January 30th was 480 times that of audibility. If the second set of signals went around the other way, their intensities, according to the square law would be

$$3^2 : 25^2 \text{ or as } 9 : 25, \textit{ i.e.}, 1 : 70;$$

hence signals which had gone the other way round would have an intensity of

$$\frac{480}{70} = 7 \text{ times stronger than audibility.}$$

As a matter of fact, the second set of signals, which we may call the echo signals, were really nearly twice as strong. This, of course, might be taken as an argument against their having come that way, but I am not disposed to consider it as a conclusive one. If, however, they did come round the other way, it is evident that the rate of absorption must become uniform after a certain distance.

I subjoin a chart (fig. 1) showing the variations for a single month in working between Boston and Machrihanish, the month taken being that of January. No sending was done on January 1st on account of its being a public holiday.

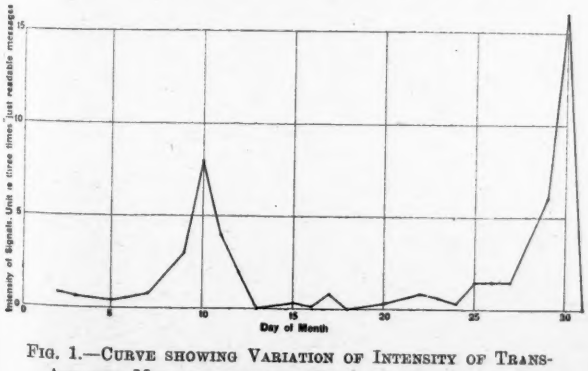


Fig. 1.—Curve showing Variation of Intensity of Trans-Atlantic Messages for the Month of January, 1906.

The intensities taken were in terms of a standard intensity, which was about three times that of the lowest intensity at which messages could be read under the best conditions.

The variation, as will be seen, is extremely great, and on three nights, *i.e.*, on January 13th, 18th and 31st, the strength of the signals received was approximately only one-thousandth of the strength at which signals were received on the night of January 30th.

On the night of January 30th, the strength of the signals received agreed almost exactly with that deduced from theoretical considerations. The signals were of course on that night quite loud, and some of the operators amused themselves by reading the messages with the telephone held 3 in. from the ear.

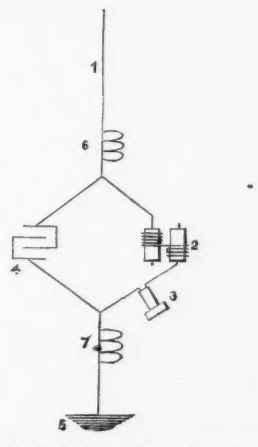
Incidentally it may be mentioned that the amount of power used in making these tests during the month was approximately 4 H.P. On a number of occasions messages were exchanged using only a single horse-power.

This atmospheric absorption will be seen to be perhaps the most important factor in wireless working over long distances. Work has been commenced on the stations at Boston and Machrihanish with a view to increasing the intensity of the signals one hundred times, and it is expected to have this work completed by the fall of 1906. When completed it will be possible to hear messages with only one one-hundred-thousandth of the strength that they come in on on the best nights. It is not proposed, however, to install one hundred times the energy, but merely to use about 50 H.P., the intensity being increased ten times by the use of a new form of receiver which is approximately ten times as sensitive as the liquid barretter.

Change of Wave-Length.

A very interesting question is whether there is any change in wave-length in transmission over long distances. Theoretically, there should be no change, but it seemed advisable to ascertain the fact.

In measuring wave-lengths the writer commenced in 1897 and 1898 by using a long solenoid and vacuum tube after the method originally devised and used by Tesla in 1893, and later by Fleming and others. It was found that this method did not give sufficiently accurate results, and, moreover, it could not be used to measure waves accurately at any considerable distance from the station. A method was, therefore, devised and put in practice in 1899, which is capable of measuring wave lengths accurately to a fifth of 1 per cent., and which at the hands of different observers on different days, has given results agreeing to one-fourth of 1 per cent. The fact may be mentioned here that the wave-length sent out by the Machrihanish station has been measured at Boston to within one-fourth of 1 per cent. by this means.



1, Antenna; 2, Variable inductance; 3, Receiver; 4, Condenser; 5, Ground; 6 and 7, Lamps.

Fig. 2.

In this method a variable inductance is used, as it is difficult to construct an accurate variable condenser having any very wide range. The Varley-Thomson rheostat was at first used as a variable inductance, but it was found that with the low voltages met with in wireless work the contacts could not be depended upon. A variable inductance on a new principle was therefore devised, in which the contacting cylinder of the Varley rheostat is made of a tube of pure electrolyte copper having a spiral thread cut in it, so that all the wire wound on to the copper cylinder forms the

primary of a transformer, which has a short-circuit secondary —namely, the copper cylinder. The wire can therefore be insulated and covered with a coat of varnish without interfering with the action of the variable inductance.

This variable inductance is placed in shunt to a standard air condenser, the resonant circuit opened, a hot-wire barretter inserted in it, and is connected to the aerial and ground as shown in the figure.

Non-inductive resistances, consisting generally of lamps, are inserted in the aerial and ground connections at the points 6, 7, as shown in the figure. This is for the purpose of rendering the antenna oscillations deadbeat, thus leaving only the supply circuit resonant, and thereby avoiding all questions of double frequencies.

With this apparatus measurements were made of the wave-lengths at different distances from sending stations, and it was found that there was no variation in the wave-length amounting to as much as one-third of 1 per cent.

Aeolotropic Absorption.

It has been found that the absorption varies in different directions on different nights. On one night stations can be readily heard which are located in the South, while on other nights stations to the East and West can be heard best. There is considerable evidence in favour of diffraction effects being produced. There are also strong indications that the

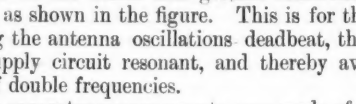


Fig. 3.

absorbing masses are not continuous, but somewhat resemble transparent clouds. There are also indications that the size of these clouds varies considerably, the diameter varying from about 150 ft. comparatively low down, *i.e.*, within five or ten miles of the ground, in tropical countries, up to masses having a diameter of at least two miles, and much higher up in the air, as indicated by the experiments between Boston and Machrihanish.

To go thoroughly into this matter would require more space than the Editor would, I believe, care to allow me. I will merely refer to some experiments made between two of our stations on the River Amazon 150 miles apart.

At these stations it was found that the signals had an intensity of 20 during the night time, but that within 15 minutes after sunrise the signals became inaudible. The curve showing the strength of the signals was very abrupt, as shown by the full line of fig. 3. After making certain changes in these stations, which somewhat increased the strength of the signals, the curve took the shape of the dotted line shown in the same figure, in which it will be seen that the slope is more gradual, and the relative change in the intensity of the signals is very much less.

Daytime and Nighttime.

As will be seen from the Amazon curve, over short distances in tropical countries the difference between daytime and nighttime is very marked. Between Machrihanish and Boston, however, so far the indications are that the difference between daytime and nighttime is very much less than that between good and bad nights. A sufficiently extended series of observations has not been obtained, but so far the indications are that the worst day is not very much worse than the worst night, while the best day is very much worse than the best night. It is expected that more will be known of this as soon as we have had time to make an extended series of observations. Up to the present time the days have been so much taken up with experimental work that there has been very little time for sending. We have, however, quite a complete set of tests between Washington and Boston, a distance of 400 miles, both daytime and nighttime, and these tests show something of the same character, *i.e.*, worst day gives signals of about half the intensity that the worst night does.

Summary.

It is too early yet to draw definite conclusions on this subject, but the following statements seem to be in accordance with the facts.

1. There are large masses of absorbing material, probably ionised air, in the upper atmosphere. Down near the surface these masses are not continuous, but somewhat resemble clouds, and their size diminishes as we approach the earth.

2. In temperate climates waves sent out do not reach up to the height of the absorbing masses, and hence are not absorbed appreciably up to distances of 100 miles.

3. Beyond distances of 100 miles the waves reach up into the absorbing matter and are absorbed. Beyond 100 miles the absorption increases at a rate proportional to a higher power than the first of the distance. Beyond several thousand miles there is a possibility that the rate of absorption becomes constant.

4. For long distances the absorption may be very great, and more than 99·9 per cent. of the energy may be absorbed.

5. Sunlight causes the height at which absorption takes place to approach considerably nearer the ground.

6. Sunlight acts by changing the air in some way, probably by ionising it. This is shown by the rapid rate at which signals die out after the sun rises, since, to take the case of the Amazonas stations, 15 minutes would not be sufficient to allow the ionised air to flow downwards to an extent necessary to produce the absorption.

7. In tropical countries the absorption height is much less than in temperate climates.

8. The absorption may be aeolotropic—*i.e.*, there may be much greater absorption in one direction than in another.

9. In the temperate zone there is considerable difference between the absorption at night and during the daytime. Between distances of 300 and 1,000 miles in the temperate zone there is considerable difference between the absorption at night and during the day-time. In distances of over 1,000 miles the difference is not so marked.

This suggests that the action of daylight is to lower the level at which absorption takes place, and hence, when stations are so far apart that waves reach above the absorbing level even during the night-time, the lowering of the absorption level during the day does not produce so marked an effect as in the case of stations whose waves lie below the absorbing level at night-time.

10. The height above the earth at which marked absorption begins to take place may be roughly estimated as about 300 miles at night time and 100 miles during daytime, for the temperate zone, and 100 miles at night-time, and 30 miles during day-time for the tropics.

(*To be continued.*)

ELECTRIC POWER AND SUPPLY BILLS AND SMOKE NUISANCE.

A memorandum has been issued by the Commissioners of Works relative to the likelihood of a great smoke nuisance from possible power stations, that may be built in connection with the London Power Supply undertakings. Quite possibly the recent nuisance from the Neasden power station may have aroused the Commissioners to a sense of the absolute indifference of the average power station constructor to the question of fuel combustion. Every engineer knows that with proper furnaces there is no need to make smoke ; yet few of them make the slightest attempt to deal rationally with the problem of combustion. Boilers are put down and the furnaces prove a failure, as an inspection of the drawings would have foretold. Then comes the period of tinkering with nostrums and mechanical stokers, which at present seems to end in the adoption of chain grates with several hundreds per cent. air excess and a CO_2 ratio of 2 per cent. or very little more.

The Commissioners of Works are the department in charge of parks and gardens, and they are very properly alarmed, not merely for their injury, but also as regards the National Museums and Galleries which cannot but suffer from the

filth-laden air of London. It is not mere soot that they fear so much as acids and oily steam discharges, which have already played havoc in Brompton Cemetery which also comes under their charge. They draw particular attention to Schedule 81 of the Electric Lighting Act, which reads :— "Nothing in the special order shall exonerate the undertakers . . . . in the event of any nuisance . . . ."

Specially referring to the Bills before Parliament, the London County Council, who profess so loudly for the public good, have so poor an idea of what could and should be done that their Bill asks exemption from proceedings for nuisance. So also do the Bills of the Administrative County of London, of the West London undertakers, the St. Pancras Council, and the Charing Cross, West End and City. Thus the inability of the engineers of all these undertakings to master the smoke problem is even to be recognised by Parliament to be so complete as to render it necessary to relieve them from responsibility.

In the Appendix to the White Paper are letters from Sir A. B. W. Kennedy and Dr. T. E. Thorpe. The former says there is no sulphur in Welsh coal: the latter says there is, and quite disposes of Sir Alexander Kennedy's contention that his Grove Road chimney actually benefits plant life, because it turns out CO_2. We are bound to say that the former letter might have come out of a comic opera, and it is satisfactory to find there is a serious rejoinder to it. Sir Alexander at most adopts a *tu quoque* attitude, justifying the steam user, whose nuisance is paralleled by the common house fire, as though one evil justified another.

That all coal contains sulphur is true, and we cannot say how far the watering of the coal with lime water would fix the sulphur in the ashes, but soot and hydrocarbon or tarry vapours, which make black our fogs, do more harm than even sulphur in rendering everything filthy. Let the sulphur be checked by lime if it can be, and let the dirt be stopped by correct furnaces, as it certainly can be. But we shall never get proper furnace practice if engineers of the high eminence of Sir Alexander Kennedy will write the sort of letter that appears here in extenuation of smoke. The letter begs the whole question, and we are sorry to see that engineers will not face the matter with scientific earnestness.

A TIME METER FOR TRAMCARS.

The question of reducing the consumption of energy per car-mile seems never to have aroused a prolonged interest in this country. It springs out of its slumber at odd intervals, is pursued with some degree of eagerness for a time which is more often short than long, and finds itself able to retire to its somnific retreat with hardly a hair turned, hounds having started and run another and a fresher hare; but there it is still ready for another day, never to be run to the death, but to be harder and harder pressed every time, now losing one piece now another of its expensive skin, until one day it will have become such a bob-tailed, mangy creature that few will think it worth the hunting.

Just now, however, its coat is bright and it is in the pink of condition, although there were times of late when hounds were hard on it before it realised the peril.

Much as we should prefer a pure English strain, we must not neglect the possibilities of foreign blood, and it may be that good hunting would follow the laying on of the Frankfort pack.

L'Industrie Electrique had in a recent number an article in which the well-known watt-hour meter method of checking the performance of motormen was pitted against a pure time-meter method, and found itself beaten at all points.

Many English lines have used unit meters in large or small numbers for long or short tests, but there is much doubt about the real value of the results in a general way, and no one, so far as we know, has made permanent use of such instruments as a part of the equipment of each car, because of the heavy initial outlay, the probably high cost of repairs, and the liability to error, which would inevitably tend to discount any conclusions, besides giving the motormen the nucleus of a grievance if any action were taken which took the meter readings in evidence.

So far as results of short period tests are available, the unit meter has confirmed the general opinion that the difference between motormen is great, and that the average performance is far below the best. The aim of everyone who has taken up the matter has been to raise the best performance higher still, but chiefly to reduce the gap between the average and the best. That is the hole into which the money rolls at present, and it ought to be possible to stop it.

In 1904 the bill for energy on the Frankfort tramways was £37,500, with the unit at 2½d. The rate, of course, was outrageous, and it was not unnatural that pains were taken to use as little energy as possible. Unit meters were tried, and were not satisfactory, for reasons which are not given. Then meters which recorded merely the time during which each car was under current were tried, and by May, 1905, every car was fitted with them.

At first sight one would suppose that a simple time record would fail of its purpose, because it gives no indication of quantity, but there is nothing like practice for demonstrating fallacies, and the result of the first month's complete trial at Frankfort was a reduction of 13 per cent. below the consumption of the corresponding month in the previous year.

That is a striking economy, and the writer of the article in *L'Industrie Electrique* considers that the *minimum* average reduction will be 13 per cent.

The Frankfurtians belong to the school which believes in hurrying over the resistance notches to obtain a high rate of acceleration, and the consequences seem to justify it in their case at least. Probably, when every driver on a system containing several hundred cars does it, the maximum demand on the station is much the same as if the general practice were to take 10 or 15 seconds over the notches, while the fear of the time meter produces a definite economy by making motormen use every chance of rolling free.

The whole object of this meter is to reduce the time during which the cars are under current and brakes. It can only accomplish the first with the aid of the second, and it must do this much more perfectly than any form of energy meter alone.

Rules by themselves, and training by itself, are not enough to ensure economy, although there is at least one case where as much as 25 per cent. was stated to have been saved by marking the poles at which current was to be cut off and put on again. There must be some tangible record which is so simple that the most clownish motorman can understand it, and it must be so reliable that he will trust it, too.

At the beginning of a trip he looks at the clock face, or the meter dial, or whatever visual record there may be, and at the end of that trip he sees that his car has been under current for so many minutes. Golfers will suggest immediately that he will know what bogy is for the hole, and will rejoice or mourn as he is under or over. In the language of the minority, a certain number of minutes will be considered a fair official average for a trip on any particular branch of the system, and the motormen will be able to rate their performances accordingly.

Watt-hour meter readings were always too complicated for the ordinary motormen, even if the meters were reliable after being knocked about for a few months, but everyone feels at home with a clock which tells you about plain minutes.

In case the idea of the motormen throwing the controller-handle round too quickly should strike panic into the minds of some, the slow moving handle in one of several forms is open to them for use in connection with the time meter, but a decently adjusted circuit-breaker is probably all that is wanted.

At Frankfort the conductor's way-bill has columns for the meter readings, which have to be recorded at the beginning and end of each trip, and presumably there is some scale of rewards and punishments in connection with the collated results.

The introduction of these meters has led to indirect advantages, as it is found that time-keeping and headway are better than before, that collisions between cars and other vehicles, as well as between cars and cars, have decreased,

and that the wear of brake-gear and wheels has been reduced, all these improvements being attributed to the cars being kept under better control, because they are not kept under current until the moment when the brakes are applied, so that stops are reached at a gentle pace.

It is obvious that a car which is uneconomical in itself for some reason such as binding brakes, hot axle boxes, or want of general overhauling, can be spotted just as well by a time meter as by an energy meter, and the only serious objection that can be raised against its use is that motormen might be tempted to race down hill in order to make up time wasted in coasting beyond the commercially economical limit. That is to say, a man might accelerate for a shorter period than would be necessary to take him to the next stop within schedule time and run his car free to a dead stop in order to make a good "under current" register, making up the lost time on the next down-grade, where nothing would be booked against him by the meter. The same objection might be raised with equal force against any kind of meter, but it is apprehended (as our learned legal contributor hath it) that the traffic inspectors and regulators are quite capable of dealing with such easily discerned faults.

L'Industrie Electrique gives no description of the meter, but it need be no more than a good clock with an electrically controlled escapement that would stand all the rough and tumble of a tramcar existence, and should cost a trifle compared to the most satisfactory watt-hour meter. In Frankfort it costs £2, as against £6 for the latter.

L'Electricien, too, contains a short article on the same subject, which describes a pure time-meter by another maker.

The system ought to do a great deal towards reducing power bills, and it is to be hoped that it will be given a trial on a large scale in England without delay.

EXTRA-HIGH-PRESSURE REGULATIONS OF THE BOARD OF TRADE.

We have received a copy of the following Regulations:—

Board of Trade Regulations as to Extra High Pressure.

(A) For securing the Safety of the Public, and
(B) For ensuring a proper and sufficient Supply of Electrical Energy.

1. The obligations imposed by these Regulations are in addition to and not in substitution for the obligations imposed by the Regulations of and these Regulations and those Regulations are to be read and construed together.

Definitions.

2. In these Regulations, the expression "Authorised Distributors" means any local authority, company, body, or person authorised by Act of Parliament or Provisional Order confirmed by Parliament to give a general supply of energy within the area of supply or any part thereof.

A.—Regulations for Securing the Safety of the Public.

3. An extra high pressure main shall not be brought into use unless, after it has been placed in position and before it is used for the purposes of supply, the insulation of every part thereof has withstood the continuous application, during half-an-hour, of pressure exceeding the maximum pressure to which it is intended to be subjected in use, that is to say, in the case of every electric line to be used for a pressure not exceeding 10,000 volts twice the said maximum pressure, and in the case of a line to be used for a pressure exceeding 10,000 volts, a pressure exceeding the said maximum pressure by 10,000 volts; and the undertakers shall record the results of the tests of each main or section of a main.

4. Every extra high pressure main shall be protected by a suitable fuse or automatic circuit-breaker, but in the case of a concentric main that fuse or circuit-breaker shall not be inserted in any external conductor thereof which is connected with earth.

5. In every case where an extra high pressure supply is transformed or converted to a reduced pressure, some suitable automatic and quick-acting means shall be provided to protect the reduced pressure circuits from any accidental contact with or leakage from the extra high pressure system, either within or without the transforming or converting apparatus.

6. All metal conduits, pipes, or casings containing any extra high pressure electric line shall be efficiently connected with earth, and shall be so jointed and connected across all street boxes and other openings as to make good electrical connection throughout their whole length.

7. Every portion of any extra high pressure electric line placed above the surface of the ground, otherwise than in a sub-station, or in any subway not in the sole occupation of the undertakers, shall be completely enclosed either in a tube of highly insulated material embedded in brickwork, masonry, or cement concrete, or in strong metal casing efficiently connected with earth.

8. Where extra high pressure mains for three-phase supply consist of insulated conductors laid together, provision shall be made to ensure that neither the ground nor any neighbouring electric line or conductor can become charged by leakage from any such main.

Where this provision is made by a copper strip under a lead sheath, that strip shall be not less than sixteen-thousandths of an inch in thickness, and where it is made by steel wires outside a lead sheath, each of those wires shall be not less than one-tenth of an inch in diameter.

Where the mains are enclosed in a lead sheath, that sheath shall be not less than one-tenth of an inch in thickness, and shall be permanently and efficiently connected with earth.

9. Extra high pressure mains for single-phase supply and all cables connected therewith shall consist either of two concentric conductors or of separate conductors. Where concentric conductors are used the insulation shall be maintained efficiently throughout, except that the outer conductor shall be connected with earth at one point, and where separate conductors are used, provision shall be made as in the case of mains for three-phase supply to ensure that neither the ground nor any neighbouring electric line or conductor can become charged by leakage.

10. An extra high pressure electric line shall not be brought into use for the supply of energy before it has been completely laid, properly jointed, examined, and tested, or until it is in the sole charge of the undertakers, and every such line shall, during its use, be in the sole charge of the undertakers.

Street Boxes.

11. Extra high pressure mains shall not pass through the same street box with other mains, unless they are enclosed in strong metal casing; and street boxes containing extra high pressure mains shall not contain pipes for water, gas, or other service, or electric mains belonging to another undertaking, provided that any such street box may contain telephone wires belonging to the undertakers.

Sub-Stations.

12. Sub-stations supplied at extra high pressure shall be established in suitable places, and shall be in the sole occupation of the undertakers or of an authorised distributor, or in the joint occupation of the undertakers and of an authorised distributor.

13. Sub-stations constructed below the surface of any street after the date of these Regulations, to which an extra high pressure is to be given, shall not contain switches or other apparatus than transformers.

14. The transforming apparatus at any sub-station supplied at extra high pressure shall be so arranged that there shall be no danger of any mains connected therewith being charged to any pressure beyond the limits of pressure for which those mains are intended.

15. In delivering the energy to a sub-station at extra high pressure the undertakers shall exercise all due precautions so as to avoid risk of causing fire on the premises.

16. All extra high pressure electric lines and apparatus placed in a sub-station shall be highly insulated and thoroughly protected against injury to the insulation or access of moisture, and any metal forming part of the electric circuit shall not, unless efficiently connected with earth, be exposed so that it can be inadvertently touched. All such lines shall be so fixed and protected as to prevent the possibility of electrical discharge to any adjacent metallic substance.

17. The officers of the Board of Trade shall be entitled to enter at all times any of the generating or sub-stations of the undertakers supplying or supplied at an extra high pressure, and to make any such examination and tests of the mains, machines, transformers, or other apparatus in use in those stations, as may appear to them necessary, and the undertakers shall afford all due facilities for any such examination and tests.

Connection of Circuits with Earth.

18. Where any extra high pressure circuit is connected with earth, the connection shall be made at one point only, namely, at the generating station, sub-station or transformer, and the insulation of the circuit shall, except at that point, be efficiently maintained throughout.

19. The neutral point of the star winding of each distinct three-phase circuit, used for extra high pressure, may be connected with earth, or may be insulated. If connected with earth through a resistance, that resistance shall be sufficiently low to ensure that the fuse or automatic circuit breaker in the mains shall act.

If the neutral point is not connected with earth, a separate electrostatic voltmeter placed in a conspicuous position in the generating station shall be connected between each distinct circuit and earth; and if the indications of the voltmeters show that the insulation of any of the circuits is faulty, immediate steps shall be taken to restore the insulation.

Penalties.

20. If the undertakers make default in complying with any of the preceding Regulations as to supply at extra high pressure, they shall, on conviction, be liable to a penalty not exceeding £10 for every such default, and to a daily penalty not exceeding £10.

The recovery of a penalty under these Regulations shall not affect the liability of the undertakers to make compensation in respect of any damage or injury which may be caused by reason of the default.

B.—Regulations for Ensuring a Proper and Sufficient Supply of Electrical Energy.

1. From the time when the undertakers commence to supply energy through any distributing main at extra high pressure, they shall maintain a supply sufficient for the use of all the authorised distributors and consumers for the time being entitled to be supplied from that main; and that supply shall be constantly maintained.

2. A main for an extra high pressure supply shall not, without the consent in writing of the Board of Trade, be used for the transmission of more than 1,000 kw. unless adequate provision is made for an emergency supply in the event of the breakdown of the main.

3. Before commencing to give a supply of energy at extra high pressure to any authorised distributor, the undertakers shall declare to that authorised distributor the minimum pressure at which they propose to supply energy at his terminals. Energy shall be supplied at a pressure not less than the minimum so declared and not exceeding that minimum by more than 12½ per cent.; provided that the Board of Trade may, if they think fit, allow an alteration in the minimum so declared upon such terms and conditions as they may think expedient, and after public notice has been given during a period of one month, in such manner as the Board of Trade may require, of the intention of the undertakers to apply for consent to alter the minimum so declared.

4. Before commencing to give a supply of energy at extra high pressure to any authorised distributor, the undertakers shall declare to that authorised distributor the frequency, that is to say, the number of complete periods per second at which they propose to supply. The frequency so declared shall be 50 or 25 complete periods per second, and shall be constantly maintained subject to a variation not exceeding 2½ per cent., and shall not at any time be altered or departed from to an extent greater than that variation except by consent of the Board of Trade, and upon such terms and conditions as the Board of Trade may impose, and after public notice has been given during a period of one month, in such manner as the Board of Trade may require, of the intention of the undertakers to apply for consent to alter the same.

5. If the undertakers make default in complying with any of these Regulations as to supply at extra high pressure, they shall, subject to the provisions of the Order (Act), be liable on conviction to a penalty not exceeding £5 for every such default, and to a daily penalty not exceeding £5.

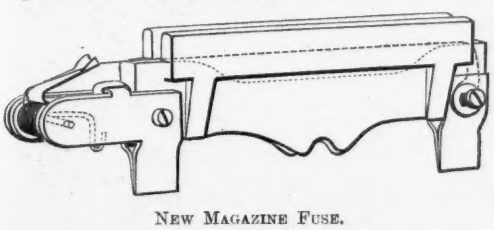
These Regulations are made subject to the power of the Board of Trade to make such further or other regulations as they may think expedient; and nothing in these Regulations shall be construed to authorise the undertakers to lay any electric line or work their undertaking otherwise than in accordance with the Order (Act) and the principal Act, or to supply energy otherwise than by a system for the time being approved of by the Board of Trade under the Order (Act).

These Regulations are, so far as they relate to factories and mines, in addition to and not in substitution for any regulations made by a Secretary of State under any Act relating to factories or mines.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Magazine Fuses.

Messrs. S. Bill & Co., of 56, Guest Street, Birmingham, are introducing a new "Magazine" fuse, which has a magazine of wire fitted on the carrier, enabling replacement to be effected in a very short space of time. The reel has sufficient wire for 50 replacements for 5 and 10-ampere sizes, and should be equal to the life of the carrier.

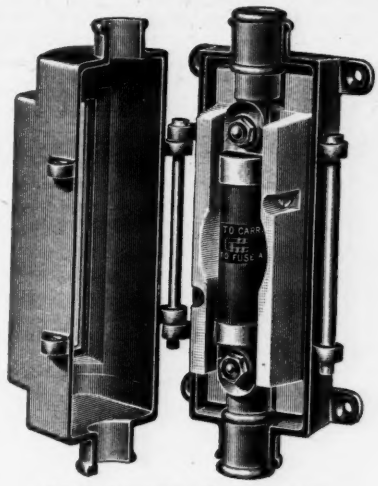


New Magazine Fuse.

The carriers are all plainly marked with their fusing limit. Messrs. Bill turn out these fuses in all sizes up to 50 amperes, and they are fitted either to distribution boards or house-service fuse-boxes. A circular describing this device, and giving prices, has been issued by the firm. We have a specimen fuse now before us, and it certainly strikes us as being ingenious and neat. There are no nuts or screws to be undone and lost.

G.E.C. Main Cut-Outs.

In the April "Progress" Sheet of the General Electric Co., Ltd., illustrated particulars and prices appear of a new pattern of the "Midget" wall plug, also of the "Colonial" magneto-telephone set for bridging work and long-distance lines, the transmitter of which is specially designed for hot climates. Reductions in prices of volt and ampere-meters and indicators are announced. The

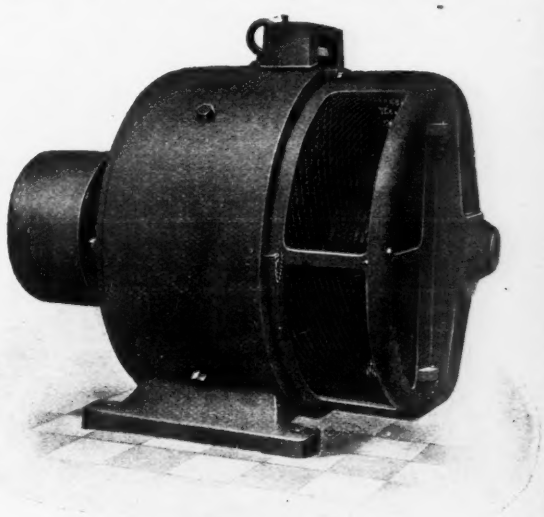


G.E.C. Improved Main Cut-Out.

accompanying figure shows an improved pattern of single-pole type main cut-out for circuits up to 250 volts. It consists of a fuse chamber cut-out fitted in a cast-iron case with hinged lid, this lid being provided with a glass front immediately over the fuse chamber, thus allowing examination of the fuse without the necessity of opening the case. The cut-out can be supplied with plain terminals, or arranged to take "Mordey" or plain fuse, as shown in the figure.

Holmes's New Motors.

Messrs. J. H. Holmes & Co., of Newcastle-on-Tyne, are placing upon the market a new line of machines which have been carefully designed to be up-to-date and which combine many important features. The design of frame, with laminated high permeability

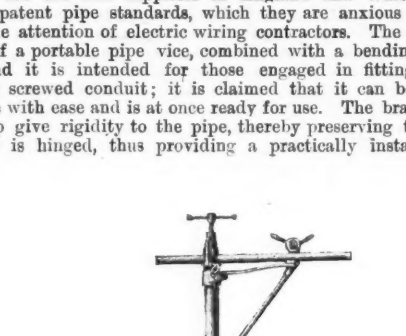


Messrs. J. H. Holmes & Co.'s New Motor.

poles of special shape, is very compact, and is claimed to ensure freedom from vibration, even at the highest speeds. Ventilation is carefully attended to, giving a very free circulation of air in every part. Great care is taken in the insulation of the windings, ample space being provided everywhere; the sub-division of the coils prevents any great difference of potential, and permits of every layer of wire being near the surface of the field coils. All parts are made to gauge so that spare parts can be obtained at any time. The constants of the design have been carefully chosen so that there is margin enough to allow any of these machines to have a 3 to 1 range of speed by shunt field regulation only and sparkless at the brushes, the highest speed being chosen within the limits of safe running. The first series has a range of 5 b.h.p. to 65 b.h.p., at normal speeds of 675 revolutions to 1,275 revolutions, but the range of possible windings with standard commutators gives a series of speeds from 200 revolutions upwards. It is stated that the machines will stand an overload of 100 per cent. for short periods. They are also wound as shunt or compound dynamos.

"Paragon" Pipe Standards.

The Oldbury Steel Conduits, Ltd., of Birchfield Lane, Oldbury, are the sole suppliers in England and Wales of the Paragon patent pipe standards, which they are anxious to bring before the attention of electric wiring contractors. The standard consists of a portable pipe vice, combined with a bending attachment, and it is intended for those engaged in fitting up gas barrel or screwed conduit; it is claimed that it can be carried anywhere with ease and is at once ready for use. The bracket and back grip give rigidity to the pipe, thereby preserving the jaws. The vice is hinged, thus providing a practically instantaneous



The Paragon Pipe Standard.

grip, the pipe being firmly clamped by one turn of a screw, and a half turn of the eccentric on the bracket. It is claimed that the combination of a pipe-bending machine with this standard is unique, and that by means of the device pipes can be readily bent to suitable standard radii without bulging, flattening or kinking, and with the minimum expenditure of time and energy. There is a tool tray attached to the standard, providing a convenient support for the screwing tools and oil-can. We understand that this pipe standard has been found of great value by a number of electric wiring contractors, and it is said that some of them have saved its entire cost on a single lighting contract.

LEGAL.

A Wireless Telegraph Scheme that Failed.

Before Mr. Justice Bigham sitting in bankruptcy on 3rd inst., the motion of in *re* J. T. Armstrong, *ex parte* T. M. de Bingham *v.* F. Salaman, trustee, was heard.

Mr. Mansfield said the case was an appeal from the rejection of a proof for some £10,000 for damages for alleged breach of contract. The case arose out of an agreement to sell wireless telegraphic apparatus, and the trustee had rejected the proof on a number of grounds. First, misrepresentation of material facts; secondly, that a company was to be formed and was not formed; thirdly, that the alleged agreements were shams; and fourthly, that the agreements had been rescinded by mutual consent, and that the appellant had suffered no damage. He read an affidavit by the appellant, who said he made contracts with the bankrupt for 3,000 and 2,000 sets of wireless telegraphic apparatus. He had interviewed persons in all the principal towns of England, and had found that he could have sold the sets of apparatus, but the bankrupt would not supply them. Consequently he had failed to make a profit.

His Lordship asked if there was any document confirming the statement as to the contracts?

Mr. Mansfield said there was not. The excuse given by bankrupt for not supplying the apparatus was that he was too busy on the Stock Exchange. The appellant said he had spent £10 per week in travelling expenses for 18 months. He denied that the agreements, as alleged, were sham agreements, and said they covered a number of counties in the North of England in which the appellant introduced the apparatus. A company was to be formed, to be called the International Wireless Telegraph and Telephone Co., and, in fact, it was registered.

His Lordship: What was to be the capital of the company?

Mr. Mansfield said the capital was to be £175,000 in £1 shares, of which the debtor Armstrong was to take 120,000 shares.

His Lordship: Was anything paid into the coffers of this company?

Mr. Mansfield could not say, but the consideration to the bankrupt was to be £120,000 in fully paid shares. The shares had been allotted to Armstrong and his nominees, and had been dealt with on the Stock Exchange.

Mr. Thomas McClelland de Bingham, the appellant, was then cross-examined by Mr. Shearman, K.C., who with Mr. Hansell appeared for the trustee. He admitted that he was a bankrupt in Belfast some years ago and had not been discharged. He said he ordered 3,000 sets of the wireless apparatus from the bankrupt to be delivered within 12 months. The cost price of the apparatus was £2 each, but the market price was £6. The sets of apparatus were not delivered, and all he had seen were about 30 at the debtor's private residence—near High Wycombe. He could have paid for them if they had been delivered. He had two banking accounts in Manchester. As a matter of fact, he did form a syndicate to work the invention, but he did not remember the names of all the members of it; there were several large merchants and manufacturers in Manchester.

Mr. Mansfield submitted that the appellant was entitled to prove for the damage he had suffered through the failure to supply him with apparatus.

His Lordship, without calling on Mr. Shearman, said he thought the trustee was quite right in rejecting the proof. The agreements came into existence to enable the appellant and the bankrupt to form a company, but he did not believe that the appellant ever had the money to buy the patent rights and the company was never properly formed. The agreements did not show grounds for damage, and the appeal must be dismissed with costs.

Wood *v.* Bolton Corporation.

The Corporation of Bolton were the defendants in an action for damages tried before Mr. Justice Bray at the Manchester Assizes on the 28th ult. On June 22nd last year a collision took place on the Corporation tramway at Hulton, in which the plaintiff, James Wood, an estate agent, received injuries, the accident having been, as he alleged, caused by the negligent driving of the car in which he was a passenger travelling from Four Lane Ends to Bolton. Substantial damages were claimed.

The plaintiff's case was that as his car was nearing the end of the loop in the St. Helen's Road it collided with one coming from the opposite direction. He was seated in the front part of the car, and seeing the danger he rose and walked towards the door. Before he could take his seat again the collision occurred. He was thrown down with great force, and besides being badly bruised his back was injured. Serious symptoms developed, ending in traumatic neuræsthenia, which totally incapacitated him from following his ordinary avocation. The front of the car was badly damaged, and the windows were shattered.

The defence was a total denial of negligence. It was an exceedingly hot day, and the tar between the stone setts on the tram track had liquefied and run upon the metals in various places, getting upon the wheels and brakes, and rendering the latter ineffective. In the loop the wheels "skidded" from this cause, and the car getting beyond control dashed into the other car, which had already come to a stand. A gradient in the line, at that point, added to the driver's difficulty.

A good deal of evidence was called on both sides.

In his summing up, the Judge told the jury that the driver knew of the existence of the tar (he had had tar removed from his brake blocks before commencing the journey); he knew that it interfered with the action of his brakes, and he knew also that he had to stop within a very short distance. He saw the car coming in the opposite direction, 50 yards before reaching the loop, and he knew also of the existence of the gradient, yet he entered the loop at more than the regulation speed. In ordinary circumstances it was admitted the car could have been brought to a stand within its own length, but apparently from the way it was managed, the accident was unavoidable.

The jury found a verdict for the plaintiff with £525 damages, and judgment was given for the full amount awarded.

Appeal by the Simplex Steel Conduit Co., Ltd.

The Master of the Rolls and Lords Justices Romer and Cozens-Hardy on Thursday last week commenced the hearing of the appeal of the Simplex Steel Conduit Co., Ltd., from a decision of Mr. Justice Buckley on a petition for revocation of letters patent brought by the Metallic Seamless Tube Co., Ltd. The learned judge had granted revocation on the ground of want of subject matter.

Mr. Walter, in opening the appeal, said that in electric lighting in this country it was usual to have the wire cased, and under fire insurance companies' rules it was compulsory. There were two systems of doing that. One was the ordinary wooden casing, with which they had nothing to do in this case, and the other was to have a series of metallic pipes throughout the building, in which the wires were laid. In addition to being put in the casing the wires were covered with some insulating material. It occasionally happened that the covering of the wire got cut off, and if the metallic casing was exposed and was not earthed somewhere, people touching it sometimes got killed. They had to deal not only with the conduits but with the fittings. When they came to an angle and had to change the direction of the pipes, it was necessary to use screwed fittings. In an electrical con-

duit, the continuity of the inner surface was a matter of importance. The invention, the letters patent of which No. 28,632 of 1903, were granted to Mr. Maxwell Waterhouse and others, consisted of a ferrule, which was screwed at one end to go into the socket, and was always screwed. The other end was larger, and had a plain socket, which fitted an unscrewed pipe of the same size as the screwed end of the socket. The ferrule was split in such a way that when it was screwed up it gripped enough on the plain tube to make an electrical contact. The problem which the patentee laid himself out to solve was to devise an apparatus which would enable people to use ordinary screwed fittings with pipes screwed or unscrewed of the same size. The amount of invention might not be large, but it was new, and performed duties which nothing else did before, and if that was not invention he did not know what was.

The further hearing was adjourned.

D. Firth & Son *v.* The Cardiff Corporation.

We have already, but only very briefly, mentioned this arbitration case. The following report has now been furnished to us:—

The case occupied the attention of the Arbitrator, Mr. W. H. Patchell, M.I.C.E., M.I.E.E., M.I.M.E., sitting at the Law Courts, for six days. The concluding hearing took place on Monday last week. Mr. Maurice N. Drucquer, instructed by Mr. R. Tweedy Smith, appeared for the plaintiffs, and Mr. J. Sankey, instructed by the town clerk, appeared for the defendants.

The claim was for £1,605 9s. 5s. for work done in installing the electric light at Whitchurch Asylum, near Cardiff. Messrs. Firth, by a contract dated October 3rd, 1905, engaged to do the wiring work at the asylum for £6,421. After making several applications to the engineer for certificates, and being unable to obtain one, the contractors withdrew their men on November 24th, 1905. In consequence of this, the Corporation took possession of the materials on the works and counterclaimed for £5,169.

The important point for the decision of the Arbitrator is whether the Corporation, without paying anything on certificates, can, notwithstanding, claim the benefit of the work done, and also counterclaim in addition.

Mr. H. D. Firth gave evidence as to the work done, and produced invoices and time sheets to support his statement. He also gave evidence as to the reading of the specification, which did not fix the size of all the cables. He read it one way, and the engineer another way, on very many points. Evidence was given that the applications for certificates with particulars of the work done were sent in on October 18th, and on November 3rd, 8th, 13th and 15th. The engineer contended that in applying for a certificate a correct statement of the work done should be supplied by the contractor. The contractor, however, gave evidence that he had given the engineer "approximate statements," and thus complied with the contract and the general custom.

Mr. Potter, of Messrs. W. T. Henley's Telegraph Works Co., gave evidence in support of the plaintiffs' claim.

Mr. Ernest Matthew Lacey, M.I.C.E., M.I.E.E., gave technical evidence as to the ambiguity of the specification.

Members of the Electrical Contractors' Association (Incorporated) also attended to give evidence as to the many meanings which could be placed upon the specification, but after Mr. Sankey had objected to the admissibility of the evidence, and the Arbitrator having ruled against his contention, defendants' counsel applied to the High Court for a special case. Plaintiffs' counsel, however, decided for the time being not to proceed with such evidence, and the case proceeded.

Mr. Arthur Ellis, M.I.M.E., M.I.E.E., gave evidence on behalf of the Corporation, and occupied the box for two days. He gave evidence in support of his reading of the specification being the right one, and in support of the allegation as to the thickness of cable, and delay, and the desire of the contractor to be relieved of the job.

Mr. H. J. Veale, chairman of the Asylums Committee, gave evidence in support of the defendants' case, and as to the counterclaim.

Mr. Cecil George Brown, deputy town clerk, also gave evidence in support of the counterclaim, and as to the extra cost the Corporation had incurred for the keep of the lunatics owing to the alleged delay, also as to the contract being relet.

Mr. Thomas, clerk of the works, also gave evidence as to the meaning of the specification, and on cross-examination admitted that his view of the meaning of the same on some points was different from that of Mr. Ellis.

The Arbitrator reserved his decision, after listening to the addresses of both counsel.

Chain-Grate Stokers. — We learn that the orders for the new Bennis-Miller-Bennett patent chain-grate which have lately been placed with Messrs. Ed. Bennis & Co., Ltd., include four for Calcutta; three for the Kensington and Notting Hill electric light and power station; and two for Messrs. Clarke, Chapman & Co., Ltd. Among the other contracts is one for 10 stokers and compressed air furnaces with necessary gearing and driving arrangements for the Bloemfontein Corporation electricity works, South Africa.

CORRESPONDENCE.

Letters received after first post on Wednesday morning cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

The Proof of Coulomb's Law.

On reading your very interesting review of "Physikalische Grundlagen der Gleich und Wechselstromtechnik," by A. Konigswerther, in this week's issue of the Review, I was at a loss to understand the statement made by the reviewer that he had not met anyone who could prove the formula $f = \frac{q\,q^1}{r^2}$ under the above conditions, such conditions apparently being that q and q^1 referred to quantities of electricity. This law under these conditions was first proved by Coulomb by direct measurement, and has been verified by many scientists since his time.

It can, however, be more rigorously established, and for an able discussion of this matter I would refer to J. J. Thomson's text-book on "Elements of Electricity and Magnetism."

I have possibly misunderstood the reviewer's meaning, and, as it is a subject of much interest, I should like more light on the subject.

Student.

[Generally speaking, text-books intended for students, referring to Coulomb's Law, state :—"This can be experimentally verified by means of the Coulomb torsion balance."

No doubt this was correct enough for the time of Coulomb, when no better appliances were at hand. The point referred to was this, that Coulomb's torsion balance (the South Kensington Exams. notwithstanding) is as dead as the proverbial "red herring."

If "Student" will try the experiment of proving Coulomb's Law, *with charges* of electricity, he will encounter formidable difficulties, to which ordinary text-books usually find it inconvenient to refer. These include leakage, &c.

However, as "Student" writes, J. J. Thomson in his text-book shows the proper way to go about proving the law of inverse squares, viz., by means of the Cavendish sphere experiments, as modified by Clerk Maxwell.

In this way it can be shown that the law differs from the square law by less than one part in twenty thousand for *charges of electricity*. Nothing like this degree of accuracy could be obtained by means of the torsion balance when charges were used; and, consequently, the writer has never met anyone who tried to prove the law in this way.

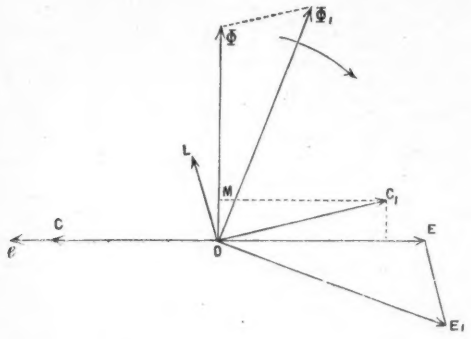
Prof. S. P. Thompson, F.R.S., in his excellent treatise, "Elementary Lessons in Electricity and Magnetism," refers to the torsion balance as "once famous, *but now quite obsolete*" (p. 19, 1905 edition.) On page 22 he says, "In practice it requires great experience and skill . . . for there are many sources of inaccuracy in the instrument . . . ."—The Reviewer.]

Neutralised Repulsion Motor.

Mr. Fynn and I are now in complete agreement, I think, with respect to the motor in question, except upon one point, viz., the phase of the motor field at F. Before going further into this, let me thank Mr. Fynn for his courtesy in withdrawing for the moment, thus obviating the confusion caused by letters which cross.

The question now is—Is Mr. Fynn right in saying that the motor field is in quadrature with the E.M.F. in the coil B? If so, then, as he points out, the motor is useless. Take that case in the third paragraph of his last letter, in which he proves that the torque is zero. By hypothesis the E.M.F. and current in the coil B are in phase: *i.e.*, there can be no E.M.F. due to self-induction in the coil B; consequently, this coil is producing no leakage flux whatever. That flux then which exists at F (the motor field) can only be produced by the current in the primary winding E; and consequently the motor field is practically in phase with the primary current. In order to make this point quite clear I give below a method of drawing the phase-

diagram for E.M.F., current and flux, assuming only the conditions mentioned above; and for clearness' sake, neglecting iron losses and primary resistance.



The motor is supposed to be on the point of starting; and in this diagram :—

O ϕ_1 is the total flux threading the coil E; it has the two components O ϕ and ϕ ϕ_1.

O e = E.M.F. in coil B.

O C = current in coil B.

O ϕ = flux which produces O e and represents, therefore, the mutual induction between E and B.

O M = the primary magnetising current, producing O ϕ.

O E = the component of the primary E.M.F. equal and opposite to O e.

O C_1 is the primary current corresponding to the sum of O C and O M.

O L is the primary self-induced E.M.F., which is chiefly due to the flux oscillating at F (the motor field).

O E_1 is the primary applied E.M.F. corresponding to the sum of O L and O e.

It is evident that the motor field (producing O L) is in phase with O C_1, for O L and O C_1 are in quadrature. This field is represented by ϕ ϕ_1.

Clearly for this case I am justified in making the following statements :—

1. The motor field and the current in the coil B are most certainly not in quadrature, and the torque is not zero.

2. The torque is proportional to the product of O C × O C_1 × cos C O C_1.

3. The torque is large so long as O C is large compared with O M.

4. The torque rapidly decreases with speed, for as the speed rises :—

(*a*) O e is reduced.

(*b*) O e and O C_1 approach one another.

(*c*) O C is gradually reduced exactly as in other series alternating current motors.

I think that this must clear up the last doubts in Mr. Fynn's mind with respect to this motor; it will also, I hope, explain to some extent the meaning of my second proposition in your issue of April 27th. Should any further doubts exist, let me assure Mr. Fynn that a rough motor which I tried on this principle showed very considerable torque; in this particular case the armature only carried the equivalent of one turn.

Other forms upon the same principle are obviously possible; as, for instance, that which is obtained by interchanging the relative positions of the limbs carrying F F and E.

William Cramp.

Manchester, *May 5th*, 1906.

Bermondsey Electricity Supply Undertaking.

With reference to the paragraph in your issue of the 4th inst. relating to the Municipal Association's advocation of the sale of the electric light undertaking and the dust destructor in the Borough of Bermondsey, I should like to point out that whatever the opinion of the Municipal Association may be, the achievement of this object is extremely unlikely, considering the facts that an increase of 64 per cent. of units sold, and a decrease of 40 per cent. in works costs have been made during the past year, also our works costs for the year ending March 31st, 1906, will be amongst the lowest obtained by metropolitan undertakings whether municipal or company, and augur well for the future.

W. E. J. Heenan,
Borough Electrical Engineer.

Bermondsey, S.E., *May 8th*, 1906.

[Mr. Heenan is to be congratulated on the excellent progress made.—Eds. E.R.]

Electric Winding at Collieries.

I have been an interested reader of the reports of the last few weeks dealing with the papers recently read before the I.E.E. on electric winding at collieries; and, whilst these have been exceedingly instructive, I hold the opinion that the question has not yet been discussed in its broadest sense.

Most mining engineers consider that, in view of the relatively large initial outlay, and, consequently, high interest and depreciation charges, the use of the electric winding engine at single collieries would not be attended by any great increase in economy over good steam winders, more especially since the introduction of suitable turbines has made possible the utilisation of the comparatively high pressure exhaust of large steam winding engines, making of the combined appliances a fairly efficient plant.

It would thus appear that the peculiar field of the electric winder is at groups of collieries where the advantages of the centralisation of generating plant can be realised, and the writer is of opinion that it would be profitable to consider the comparative costs and efficiencies of steam and electric winding engines under such conditions with the cost of installing and operating the necessary boilers included. The question would then embrace the total cost of working groups of mines of given output wholly by electricity as against the same mines operated wholly or partially by steam power.

There is no doubt regarding the higher efficiency of electric over steam plant for most mining operations, and, supposing a group of mines to be worked exclusively by electric power generated at one central station, and assuming a fairly good load factor, perhaps half the boilers necessary to operate the mines directly by steam might be dispensed with. The economy is obvious.

F. J. Stuart-Milne.

Rotherham, *May 7th*, 1906.

Preferential Rates.

I notice in your issue of the 27th ult. "Brig" asks if you, or any of your readers, know of any of the leading electric lamp manufacturers quoting supply corporations better terms for lamps than they do to contractors or merchants.

It might interest "Brig" to know that I have before me a quotation from one of the oldest and best-known firms, and they quote 12½ per cent. better than they quoted a contractor and merchant for the same quantity of lamps.

I am trying to find out if this firm is a member of the Manufacturers' Association.

If they are, does this Association allow such a thing?

Inquirer.

Separation of Oil from Feed Water.

As an interested reader of your paper, and particularly of the discussion as to separating oil from the water of condensation, I would like to know of what use is the oil recovered? Will it do for the cylinders of high-speed engines, or what?

Filter.

Overhead Wires Regulations.—With further reference to a correspondent's inquiry in our last issue, it has been pointed out to us that the regulation limiting the power transmitted by one overhead conductor to 50 KW. is obsolete. —Eds. E.R.

BUSINESS NOTES.

Condensing Plants. — We are informed that the Mirrlees Watson Co., Ltd., has a long list of orders in hand for condensing plants, among which are the following:—

Surface Condensing Plants.

South Metropolitan Electric Power Co., Ltd. (per Willans & Robinson, Ltd.), duty, 33,500 lb. (Repeat order.)
Clyde Navigation, Clydebank Dock (per Babcock & Wilcox, Ltd.), two sets, duty, each 12,500 lb.
Kearsley Spinning Co., Ltd. (per Electrical Co., Ltd.), duty, 13,500 lb.
Leyton U.D.C. (per Brush Electrical Co., Ltd.), duty, 12,600 lb.
Rand Water Board (per British Westinghouse Co., Ltd.), duty, 15,000 lb.
Shieldhall Catford Works (per Lowton Bros. & Co., Ltd.), two sets, duty, each 13,500 lb.
J. & P. Coats, Ltd. (for works at Lucca), duty, 7,000 lb.
Cie Francaise pour l'Exploitation des procedes Thomson-Houston (for Tunis), two sets, duty, each 18,700 lb.
Bristol Corporation (per British Westinghouse Co., Ltd.), duty, 44,000 lb.

Sub-Base Surface Condensing Plants.

County of London Electric Supply Co., Ltd., Wandsworth Station, and City Road Station (per British Thomson-Houston Co., Ltd.), two sets, each 29,250 lb.

Also several elevated self-draining jet condensing plants for collieries.

France.—The balance-sheet of La Compagnie d'Electricité Thomson-Houston de la Mediterranée for the last financial year shows a net profit of £33,585, which admits of a dividend of 20 fr. per share.

Catalogues and Lists.—Messrs. Francis Morton and Co., Ltd., near Liverpool.—Illustrated and priced circulars describing the Hamilton pattern riveted steel poles for telegraph and arc lamp purposes.

Messrs. Elliott Bros., Lewisham, S.E.—Pamphlet A.C. 71 giving prices and descriptive particulars of the firm's type FF alternating current instruments. No. A.C. 83 describes the QQ recording ammeters, voltmeters, and wattmeters of portable type, and A.C. 82 is devoted to RR instruments of the switchboard type.

The British Thomson-Houston Co., Ltd., Rugby.—Pamphlet No. 194 describing their A C T induction meters for single and polyphase alternating current circuits.

Mr. C. E. Knowles, Holmdale, Glossop.—Circular containing an illustrated description of Knowles's patent porcelain lampholder, its construction and advantages.

The Electric and Ordnance Accessories Co., Ltd., Birmingham.—New leaflet, No. A 37, giving a brief account, with illustrations and prices, of the Stewart "New Improved" enclosed arc lamps; also No. F 68 particularising, showing and pricing "Stellite" electric fans.

The Dewsbury Electric Manufacturing Co., Ltd., Kilpin Hill, Dewsbury.—Small pamphlet containing a general specification of their direct-current motors and dynamos.

Messrs. H. T. Boothroyd, Hyslop & Co., Akenside Street, Bootle, Lancs.—New illustrated list, 12 pp. in red binder, very neatly produced, showing and describing the standard **E** type continuous-current motors and generators. Dimensional particulars and prices are included. A second list (4 pp.) gives an illustrated description, with a table of outputs and speeds, of type "S" direct-coupled generators for ship lighting, mill, country house and other purposes.

The General Electric Co., Ltd, London, E.C.—Leaflet giving priced information concerning battery lamps for amateurs and decorative work. Also a circular relating to the prices of French fittings and bronzes, other than those in the company's fixtures catalogue.

The Pulsometer Engineering Co., Ltd., Reading.—Catalogue just issued containing a full description, with some excellent half-tone illustrations, of the "Karoome" high economy boiler feed pumps of both simple and compound types. Among the pictures are views of a combined pump fitted in an electricity supply works, and of a pump room in a London generating station, with explanatory line diagrams of the "Karoome" pumps.

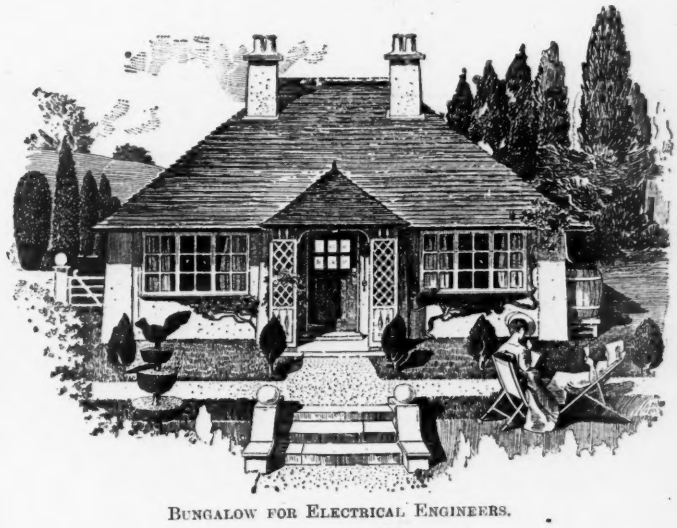
Messrs. E. Reader & Sons, Nottingham.—Three lists relating to the firm's steam engines and dynamos. One of the lists gives dimensions, descriptions and prices of their vertical enclosed-type high-speed engines specially designed for high speed with full load. Lists Nos. 10 and 12 give illustrations of coupled engines and dynamos, with general descriptions. In each of these lists is given a useful table of outputs in kilowatts, at speeds and steam pressures named, approximate shipping weights, measurements and prices. Messrs. Reader & Sons, not being dynamo makers, are in a position to supply engines adapted to, or actually coupled to, any make of dynamo.

Messrs. Richard Wade, Sons & Co., Ltd., Hull.—Catalogue of creosoted telegraph poles and timber for overhead power transmission, telegraph and telephone lines. Some notes are given on the value of creosoting timber to preserve it. The half-tone illustrations include photographic views of the 10,000-volt transmission line and poles designed and erected by Messrs. Callender's Cable Co. for the Lancashire Electric Power Co., Ltd., Messrs. Wade being the makers of the poles. There is also a view showing the process of fitting together a special four-member terminal pole for a 10,000-volt overhead transmission line at Gelli, South Wales. Line drawings of various poles are also published.

Canadian Trade: One Reason for British Failure.—The Ottawa correspondent of the *Evening Standard* quotes Sir William Van Horne, the chairman of the Canadian Pacific Railway, who has returned from a visit to England, as follows:—

"So far as Canada is concerned, the British people have not availed themselves of their opportunities so well as they might have done. The manufacturers and the merchants do not take the full advantage of their opportunities. They could do more if they came here themselves to look into the conditions; but instead of coming here themselves to open up and develop trade relations, they usually send a boy. The head of the house does not come. What do we find? It might naturally have been supposed that the tariff preference of 33⅓ to Great Britain would have given her such an advantage that no other country would have been able to contend against her in this market; but you have only to look at the commercial statistics to see how the trade of the United States with Canada has advanced in spite of the British preference."

Bungalows for Electrical Engineers. — Messrs. Oetzmann & Co. have lately had on view at their showrooms in Hampstead Road, W., some bungalow cottages, of which they are now making a special feature. In these days of high pressure there are some even in the electrical profession who find it necessary to make time for rest and quiet "far from the madding crowd"—at any rate for week-ends, and a bungalow of this description in some secluded spot beside the river or the sea, or in some unmolested rural quarter, is just the very thing in which to enjoy oneself with a few friends in comfort and simplicity. Of the bungalow cottages which have been on view at Hampstead Road, we need say little, save that they are compactly and artistically designed by a West End architect, who was expressly engaged to plan a substantial cottage which should give the maximum of accommodation in the minimum of space for a very low cost. For a couple of hundred pounds, with an additional 40 to 60 guineas for furnishing, it is possible to secure one's heart's desire. Messrs. Oetzmann have introduced special lines of furniture suitable for their bungalows.



Bungalow for Electrical Engineers.

Industrial Redistribution.—We have received from Messrs. Leopold Farmer & Sons, auctioneers and estate agents, of 46, Gresham Street, E.C., a leaflet reprinting an article which recently appeared in *Engineering* on "London's Decadence as a Manufacturing Centre." We have already dealt with the subject to some extent in the Electrical Review with a view to showing the claims of the N.E. Railway area. The article before us directs attention to the effects of migration to the country upon property and plant within the metropolis, a subject in which Messrs. Leopold Farmer have had special experience which goes to show that when a factory building is now vacated the rental value is reduced by almost one-half, owing to the limitations of the L.C.C. regulations, and the changes required to make the building effective. In many cases it is impossible to let the buildings for the same purpose as that for which they were formerly utilised, and there is little demand for machinery which is put on the market second-hand, as the importance of adopting absolutely new and modern machinery is becoming more and more realised.

"Linolite."—The Linolite Co. have just delivered 360 ft. of linolite to Messrs. Waring & Gillows for part of their new premises in Oxford Street, W. They have also recently delivered 450 ft. to Messrs. Belshaw & Co. for lighting a country house.

German Enterprise.—The Berlin correspondent of the *Daily News* states that the German Oversea Electrical Co., which is closely connected with the A.E.G., is increasing its capital from £360,000 to £720,000, for the extension of electrical enterprises at Monte Video and in Chile.

Russia.—The balance-sheet of La Compagnie d'Electricité du Midi de la Russie for the last financial year shows a profit of £7,644.

Amendment of Patent.—Notice is given by Richard Weinmar, of Baden, of intention to apply for amendment of Specification No. 12,789, of 1899, relating to "Improvements in telephone systems."

Book Notices.—*The Channel Tunnel: Its Commercial Advantages.*—This is a 60 pp. booklet in which there is brought together a great deal of interesting matter that has been published in the Press recently, both describing and discussing the scheme. As there is a probability of the matter being revived and again occupying the attention of Parliament, the compiler of the pamphlet has had reprinted a summary of the evidence given by the commercial witnesses when the matter was investigated by the joint Parliamentary Committee which sat 20 years ago.

Messrs. Archibald Constable & Co. will publish very shortly a new book by Prof. Harry C. Jones, of the Johns Hopkins University, entitled "The Electrical Theory of Matter and Radio-Activity."

"Proceedings of the American Society of Civil Engineers." Vol. XXXII, No. 4, April, 1906. New York: The Society.

"The School of Mines Quarterly." Vol. XXVII, No. 2, January, 1906. New York City: Columbia University. 50c.

"Finances of Gas and Electric Light and Power Enterprises." By Wm. D. Marks. Philadelphia, Pa.: The Author, 218, Bourse. $2.50.

"Die wirklichen Grundlagen der elektrischen Erscheinungen." By Johannes Zacharias. Berlin: Julius Bohne. M. 6.

"The Engineering Press Index Monthly Review." Vol. VII, No. 6, March, 1906. Brussels: Association-de-la-Presse Technique. 2.50 fr.

The Yachting Monthly is a new illustrated magazine published at 1s. net from the offices of *The Field*. It is a bulky and well illustrated publication containing a great many interesting and valuable articles on yacht designing, building, engineering, marine motoring, racing, navigation, and so on. If the high standard of the first number be closely followed the journal should have a successful career.

An Exhibition of Small Motors.—According to the *Board of Trade Journal* the Société d'Agriculture, Sciences et Industrie, of Lyons, is to hold from July 1st to August 15th a competition and exhibition for electric motors (in operation) of less than 1 H.P., such as would be used, for example, for driving sewing, embroidery and knitting machines, carpet-cleaning machines, grinding machines, and for numerous similar purposes. Exhibits must be accompanied by full descriptions. Plans and photographs, unaccompanied by the apparatus, may be exhibited, but will not be admitted to the competition. Applications for space, which is free, should be made at once to the society, at 30, Quai Saint Antoine, Lyons.

Trade Announcements.—The Dewsbury Electric Manufacturing Co., Ltd. (late Rodger & Kaye) ask us to mention that they have now removed their works to Dewsbury, and have laid down up-to-date plant for the manufacture of electric motors and dynamos, as well as continuing their former speciality of cranes and winches. They are now in the position to supply motors and dynamos from ½ to 30 H.P. from their standard designs.

The Electro-Medical Prosecution at Wolverhampton.—"Professor" Albert Edward Richard, whose case has been referred to in our pages on several occasions recently, has been committed for trial at Wolverhampton. A good deal of evidence has been given by witnesses who swear that Richard's treatment benefited them.

Dissolutions and Liquidations.—Taunton and West Somerset Electric Railways and Tramways Co., Ltd.—Creditors must send particulars of their debts, &c., to the liquidator (Mr. P. N. Gray, Donington House, W.C.) by June 15th.

South Shields Tramway and Carriage Co., Ltd.—Creditors must send particulars of their debts, &c., to the liquidator (Mr. W. F. Cox, Donington House, W.C.) by June 14th.

Wear Electrical Engineering Co., Ltd.—A meeting will be held at 46, John Street, Sunderland, on June 13th, to hear an account of the winding-up from the liquidators.

G. W. Green & Co., mechanical, electrical and consulting engineers, Crown Works, Guildford Street, Lambeth.—Messrs. G. W. Green and R. Poole have dissolved partnership. Mr. Green attends to debts, &c.

Telescriptor Syndicate, Ltd., 34, Victoria Street, S.W.—A first and final dividend is payable on May 9th at 3, Frederick's Place, Old Jewry, E.C. It will consist of one fully paid share in the Surrey Syndicate for every £1 owing to creditors, and one fully paid share therein for every 20 shares held in the Telescriptor Syndicate, Ltd.

J. G. Statter & Co., Cornwall Buildings, Newhall Street, Birmingham.—Messrs. J. G. Statter, G. V. Fowler, C. J. Simeon and E. A. M. Blindloss, have dissolved partnership. Messrs. Statter, Simeon & Blindloss will continue the business under the old style.

The Sun Foundry Co., Ltd., Bradford.—Mr. John Butterfield, who was appointed receiver on behalf of the debenture-holders on April 23rd, and liquidator of the company on May 1st, has issued a trading account and balance-sheet. There was a net loss of £483 on trading between June, 1905, and April, 1906, and the costs and damages in the action of the Davidson Sirocco Fan Co., against the company for infringement of patent, were £1,967—the latter being the principal cause of failure. A meeting of creditors will be held shortly. Claims should be sent to Mr. Butterfield, at 2, Darley Street, Bradford.

For Sale.—On May 16th Messrs. P. Huddleston and Co. will offer for sale by auction a quantity of electrical plant and fittings at Hammersmith.

Tynemouth Corporation is inviting offers for the purchase of a 600-kw. Belliss-Siemens continuous-current generator, which is still in the respective makers' works. The Corporation does not need the plant, as it has now arranged for bulk supply.

The Maidstone Corporation invites offers for 140 maximum demand indicators. See our advertisement pages for particulars.

Printing Press Control.—Messrs. Kohler Bros., of 56, Ludgate Hill, E.C., and Chicago, have sent us some circulars relating to their multiple push-button automatic speed control system for the electrical operation of printing presses, which we learn is installed at the offices of the *Morning Post* in London, the *Sporting Chronicle* in Manchester, and *Le Matin* in Paris. The firm has also secured the contract for driving the new four-roll Goss presses for the *Statesman of India* offices at Calcutta, and for the complete electric power equipment for the stereo machinery of the same office. One of the circulars gives a list of a number of American newspapers and printing establishments where the Kohler system is in service.

The German Turbine Syndicate.—The German turbine combination, which is composed of the Siemens-Schuckert Works Co., the subsidiary company of the North German Lloyd, the F. Krupp Co. and the Augsburg Machine Works, has received considerable orders this year for Zoelly turbines of from 1,000 to 3,000 H.P. These have been placed mainly by coal and mining companies, as, for instance, by the Laura Hutte for the Dubensko mine, the Georgs-Marien Bergwerks Verein, the Ewald pit, the Graf Schwerin, and others, while a foreign order has been given by the Moravian-Ostrau Coal Co-operative Association. The most interesting contract relates to a turbine of 7,000 H.P., which has been ordered by the Rheinish-Westphalian Electricity Works Co., which has hitherto used turbines of the Parsons type.

Consular Notes.—Italy.—The British Consul in Rome reports that the electric power which is used in Rome for traction as well as for illumination, has hitherto been supplied by the plant erected at Tivoli, the waters of the River Aniene being utilised for that purpose. The plant chiefly belongs to a private company, but owing to the price which is charged for electricity, it is only the well-to-do classes who can afford to have electric light in their houses, and very few of the streets of the capital are lighted by electricity. A scheme, however, has been quite recently submitted to the Rome Municipal Council, according to which it is proposed to utilise the large quantity of water existing in the neighbourhood of Subiaco, at a distance of about 44 miles from Rome, and to build an electric plant for the distribution of light to the capital. Under the proposed scheme, electric power would be supplied at lower rates than the present ones, and the service would be under the direct control of the municipality. The system of transmission is to be similar to that existing, the electric power being conveyed to Rome by means of overhead wires.

California.—The British Consul at San Francisco, in a report dated April 2nd, 1906, states that Los Angeles county early became a fruitful field for electric railroad enterprises, and during the last few years the southern metropolis has been brought, by means of many new electric railroads, into close communication with nearly every community and pleasure resort within a radius of 30 miles. The interurban electric railways in the neighbourhood of San Francisco do not aggregate a large mileage, but Central and Northern California have recently entered upon a period of unusual activity in electric railway construction, giving promise of large results in this direction. A company is now engaged in building a road from Merced to the Josemite Valley, and the Southern Pacific and Santa Fe Companies have jointly formed a corporation and undertaken the work of making surveys and obtaining right of way with the idea of building a parallel line between the same points. A third road, known as the Josemite Short Line, and brought into existence by the Sierra Railway, is also reaching towards the Josemite Valley from a point of connection on its line. This latter road, however, will be operated by steam. From this it would appear that travel to the Josemite Valley will be greatly facilitated in the near future. The Ocean Shore Railway is actively engaged in building a double-track electric railway to connect San Francisco with Santa Cruz. The road will skirt the ocean shore for the greater part of the distance, and will open up a rich country heretofore deprived of much-needed transportation facilities. The Napa and Lakeport Railroad Co. is another big project. It has completed surveys for right of way for an electric road from Napa to Lakeport on the shores of Clear Lake and, in connection with another company, it intends to construct another road, which will extend from Clear Lake to some point on the bay of San Francisco, making a system, with its branches, of 120 miles.

The Vice-Consul at Los Angeles, in the same connection, reports that the City and district are well supplied with electric tramways and railroads; there are about 400 miles of double track electric roads centring in Los Angeles and running to the suburban towns close by. Nine of these roads connect Los Angeles with seaside resorts (from 16 to 30 miles distant); one road to Redondo (25 miles) is about to install cars propelled by gasoline engines instead of the electric power now used. It is estimated that a speed of 1 mile per minute will be attained; at present the electric cars average 40 per hour, special cars known as flyers making a higher rate of speed. A new line to Santa Ana (34 miles) was opened during

last year, also a new line to Sierra Madre (18 miles). A second line to San Pedro (25 miles) was also opened in 1905. There are two electric roads to Pasadena, 10 miles north of Los Angeles, and a third is just being completed. The Pacific Electric Railway Co. state that several other lines are projected, "but as the management has not definitely decided to proceed to the construction of these lines it would be premature to give out data regarding them." An electric railway in now being constructed from Los Angeles to Hueneme, a distance of 60 miles. The line is to be extended to San Francisco in competition with the Southern Pacific Co. As a result of the facilities for transportation, the population of the beach towns, that is, the seaside resorts near Los Angeles, has increased in the past year from 30,000 to about 100,000.

MEXICO.—The Austro-Hungarian Consul at Mexico City in a recent report states that the number of concessions granted for the appropriation of water power showed a great increase in 1905. Concessionaires are obliged to draw up plans for the works within six months, to commence the actual works within two years, and to complete the whole within five years from the time of receiving the concession. Exemption from duty is allowed for the materials required for the work, and during the first five years the capital is exempt from duties and taxes. Great development is being made in the production of electric energy by water power, and there is a good opening for foreign capital.

CHINA.—The German Consul at Tientsin reports that the Chinese Government have erected a new telegraph line between Peking and Tsinanfoo, and a second from Peking to Jehol-Kinchau to be used for military and political purposes. The Peking-Tientsin-Taku telephone line, constructed in 1900 with Danish and German capital, has been bought up by the Government (Imperial Chinese Telegraph Administration) so that all the telephone lines are now under one authority.

LIGHTING and POWER NOTES.

Australia.—ADELAIDE.—The Adelaide Electric Supply Co. has announced reductions in its lighting tariffs as from April 1st. The flat rate of 7d. is to be reduced to 6d. per unit, and the alternative maximum demand rate from 8d. and 3d. to 7d. and 3d. The power rate of 2½d. per unit is not altered.

MELBOURNE.—Some time ago the Victorian Full Court, at the instance of the Metropolitan Gas Co., decided that the City Council had infringed the provisions of the E.L. and P. Act by not charging uniform prices for energy. One rate fixed the price at 4½d. per unit on the actual amount used, and another fixed the rate at 7d. per unit for 45 hours' consumption on a certain basis, and 2d. per unit on the balance supplied during that month. The High Court, on appeal, has reversed this decision. The Chief Justice said the words of the Act were capable of two meanings. They might mean that the charge was to be a single identical price for every unit supplied, or mean that the charge shall be at a price uniform for the supply under the same conditions. His Honour thought that the latter was the proper interpretation to be given to that section, which was directed against preference as between persons supplied, and did not direct that a single identical price was to be charged to all persons and for all purposes.

Bristol.—The Electrical Committee of the T.C. has recommended the Council to apply for a loan of £103,554 for extensions to the electricity works.

Burgess Hill.—The B. of T. has informed the U.D.C. that it will defer consideration of the question of revoking the E.L. order for a year, but intimated that if, at the expiration of that period, the undertakers could not furnish the department with evidence that the order was being put into force, it would be revoked without further notice.

Burnley.—The electrical engineer having reported that, owing to the scarcity of water for condensing purposes during the summer months, it was necessary to adopt some means to obtain a plentiful supply of cold water, the T.C. has accepted the tender of the Klein Engineering Co., of Manchester, for the erection on land adjoining the works of an open-type cooling tower, and a concrete tray. A tender for a new boiler has also been accepted.

Canada.—From the *Daily Chronicle* we gather that the Ontario Government is to introduce a Bill to control the rates to be charged for electrical energy, and to provide for compulsory expropriation of companies which refuse to sell to Canadians at as low a price as to the United States consumers.

Cannock.—The E.L. order of the U.D.C. is to be transferred to the Shropshire, Worcestershire and Staffordshire Electric Power Co.

Carlisle.—The Electricity Committee of the T.C. on May 2nd decided to apply to the L.G.B. for a loan of £6,070 for extensions of the plant at the electricity works.

Chelmsford.—The E.L. Co. has reduced the price of energy for lighting from 6½d. to 6d. per unit, less ½d. per unit for prompt payment of accounts. A sliding scale to 4½d. per unit has been fixed for consumers of over 500 units per quarter.

Clacton-on-Sea.—The charges for energy have been fixed by the T.C. at 5d. per unit for lighting and 3d. for power.

Cleckheaton.—The U.D.C. recently applied to the L.G.B. for a loan for electricity purposes. The Board has sanctioned only £3,810, having deducted £194 in respect of condensers, motors and pumps; £60 in respect of house service boxes, &c.; and £130 in regard to meters.

Continental Notes.—RUSSIA.—At the commencement of the present year, the central station of the Societé d'Eclairage Electrique de St. Petersburg was supplying current to an equivalent of 354,401 10-C.P. lamps, as compared with 319,563 at the beginning of 1905. The output of energy during last year was equal to 14,683,173 KW.-hours, as against 14,639,100 in 1904 and 12,607,963 in 1903. The net profit for the past financial year amounted to £26,772, out of which £4,740 is being put to reserve, £22,000 paid away to shareholders in the shape of a dividend of 12½ fr. per share, the sum of £32 being carried forward.

GERMANY.—The Municipality of Dortmund has just voted a sum of £58,000 for the extension of the electric lighting station.

FRANCE.—La Société Parisienne pour l'Industrie des Chemins de Fer et des Tramways Electriques is largely extending its works at Jeumont. It is also intended to establish a large electricity generating station for the supply of energy for power purposes in the Maubeuge, Jeumont and Louvroil industrial districts. The plant will, it is stated, have a capacity of 30,000 H.P.

Croydon.—The T.C. has applied to the L.G.B. for a loan of £800 for the provision of a new battery in connection with the E.L. installation at the hospital.

Derby.—A report has been presented to the T.C. by the E.L. Committee, asking for the sum of £8,130 to meet the expenditure on capital account for the ensuing year. It includes £3,360 for mains, £1,500 for motors for hire, £1,180 for meters, £600 for services, £490 for a spare armature, £500 for contingencies, &c. The report was adopted, and application is to be made to the L.G.B. for sanction to borrow the money.

Devizes.—It was reported at a meeting of the T.C. on May 4th that negotiations had been opened with a firm of consulting engineers with regard to carrying out the E.L. order, but they had proved futile.

Durham County.—The C.C. has, by 33 votes to 28, refused to re-appoint the Electricity Supply Committee which was formed to draw up proposals for municipalising electricity in the county. The Committee had prepared a report deferring for the present any definite recommendation with regard to the formulation of a scheme for the supply of electricity throughout the county, and recommending the Council to entrust the Committee with the supervision of the operations of existing and future electrical supply and traction companies.

East Ham.—The flat rate of 3¾d. per unit for ordinary lighting is to be reduced to 3½d., the new rate to come into force during the current quarter.

Faversham.—The T.C. has by five votes to two rejected a motion favouring the disposal of the electricity undertaking.

Hanley.—Mr. C. H. Yeaman has issued his report, which is quoted at length in the *Staffordshire Sentinel*, on the working of the Corporation electricity undertaking for the year ended December 31st last. The plant in use does not appear to offer much chance of successful operation, but nevertheless Mr. Yeaman has cause for congratulation, in so far as the costs per unit sold have been reduced from 3·72d. to 3·51d. Up to August last the day load was taken by a 100-KW. Brush rope-driven set, but complaints having been made that motors did not start up well, or stand variation in load satisfactorily, after investigation it was found desirable to take the load on a heavily fly-wheeled engine. The sets available were of larger capacity, from 500 to 600 KW. Considerable increase in coal and oil charges accrued. One engine for the better part of the year was run on the H.P. cylinder, owing to a breakdown, and has only been able to take two-thirds of its full load. While some of the plant can still be run, Mr. Yeaman questions whether it pays to continue its use. The report states that other alterations necessary are the removal of the smaller sets to the destructor works, replacement of the copper pipes in the steam-range, the enlargement and modernisation of the sub-stations, the relaying of the old rubber cables on the solid system, the conversion of the centre of the town to the three-wire system and other works which will necessitate the expenditure of a considerable sum of money. Also the requirements of the Home Office in the new 1905 B. of T. regulations have to be met. The profit for 1905 is given as £1,449.

Mr. C. E. Bullock, chartered accountant, has reported having examined the accounts of the undertaking, and in regard to the figures for 1904, has made certain alterations and additions. According to the 1904 accounts, the profit on the working of the undertaking from its commencement to that date, without bringing into account contributions from the district fund in respect of losses, amounted to £1,354, but the effect of the alterations made, reduces this sum to £215. £1,150 was allocated to the rates in December, 1904. The amount due to the General District Fund at the same date was £1,444.

Heanor.—The Derbyshire and Notts Electric Power Co. having approached the U.D.C. with regard to a scheme of E.L., a special Committee has been appointed to go into the matter and report.

India.—Hooghly River Power Scheme.—The promoters of this scheme, in their application for a license, state that they propose to supply direct current at 600 volts, or polyphase current at 10,000 volts between each phase. The maximum charges for which permission is sought are:—Up to 100 hours at maximum load, 4 annas (*i.e.*, 4d.) per unit; up to 200 hours at maximum load, 2 annas per unit; and above 200 hours at 1 anna per unit. The estimated capital required is provisionally fixed at £300,000.

Our contemporary, the *Indian Daily News*, after reviewing the scheme in a really intelligent manner, comes an amusing howler over the term load factor. It gravely informs its readers that the existing Calcutta Electricity Supply Corporation has "one distinct advantage," as "its load factor is much smaller."

Other Power Schemes.—It is announced that Messrs. Killick, Nixon & Co. are organising power distribution schemes for Karachi and Ahmednagar.

London.—The Metropolitan Area.—The Metropolitan Paving Committee has received a reply from the L.G.B. to its request that the Prime Minister and the President of the L.G.B. should receive a deputation from representatives of the Metropolitan B.C., on the subject of the inconvenience caused by the opening of streets by public companies and others having statutory rights. The Board's communication is to the effect that the Government are not yet in a position to express an opinion on the findings of the Royal Commission on London Traffic, and that as no legislation could be anticipated this session on the subject, the President of the L.G.B. does not think it necessary to trouble the deputation to attend at the present time. The Committee are to ask the President to receive a deputation in the autumn in order that the views of the Councils may be impressed on the Government before the details of the Government Bill are settled.

Hackney.—The Borough Council is to take up an L.C.C. loan of £4,000 for E.L. purposes. To meet the increasing demand for energy for power at the east end of Well Street, the supply network at this point is to be strengthened. The cost is estimated at £1,352.

Lambeth.—The South London Electric Supply Corporation is to construct six underground distributing centres in order that the increasing load upon the mains may be effectually dealt with.

Mansfield.—The T.C. on May 4th decided to apply to the L.G.B. for the following loans:—£2,000 for commitments; £3,000 for accumulators; £1,000 for feeder mains; £1,700 for ordinary mains; and £300 for water softening plant.

Newark.—The B. of T. having intimated that unless the E.L. order is put in force by March 7th next, it will be revoked, the T.C. will, at the June meeting of the Council, consider the advisability of proceeding with an exclusively municipal scheme.

Newcastle-on-Tyne.—The opposition to the Newcastle-on-Tyne Electric Supply Co.'s Bill is being overcome. A deputation of the Tynemouth Corporation has interviewed the promoters, and, our correspondent understands, satisfactory terms have been arranged, the details of which are in course of settlement. It is stated that the company are to have no *locus standi* to supply electricity in the borough. At a meeting of the Whitley U.D.C. on the 2nd inst. the clerk said the deputation of the Council had held a consultation with the solicitors to the Newcastle-on-Tyne Electric Supply Co., and had succeeded in practically getting the matter arranged.

Sheffield.—At the meeting of the Electric Light Committee on the 1st inst., a recommendation of the Finance Sub-committee that the Electric Light Committee should hold an electrical exhibition in the Corn Exchange in the autumn was adopted.

Swanage.—The B. of T. has granted a prov. order for E.L. for the Swanage district to the Bournemouth and Poole Electricity Supply Co.

Swindon.—The T.C. has decided to have 111 street gas lamps converted into tantalum electric lamps at a cost of £253.

Stourbridge.—The U.D.C. on Monday decided to dispose of the E.L. order to the Shropshire, Worcestershire and Staffordshire Electric Power Co. for £500, the Council to have the option of repurchasing the order at the end of 15 years.

Tamworth.—The T.C. on May 3rd passed a resolution confirming the action of the Committee in transferring the E.L. order to the Shropshire, Worcestershire and Staffordshire Electric Power Co., who will pay the Council £200 towards the £250 costs incurred in obtaining the order.

Tasmania.—The Mount Lyell Mining and Railway Co. has decided upon extending its power plant, and has placed an order with the Australian Metal Co. (representatives of Messrs. Brown-Boveri) for a new 400-kw. Parsons-Brown-Boveri turbo-alternator, similar to two machines supplied by them last year.—*Australasian Hardware and Machinery.*

Walmer.—Messrs. Foote & Milne, Ltd., have offered to take over the E.L. order of the T.C. under a prov. order empowering the transfer, the Council to borrow the capital for carrying out the work, and to have power to take over the works at any time on giving a year's notice; but if this power is exercised before the end of 10 years, the Council to pay the net losses in running the works, and 5 per cent. interest. The company undertake to repay the loan to be obtained by the Council by annual payments. The E.L. Committee is to confer with the firm.

Warrington.—The T.C. has received from the L.G.B. sanction to raise a loan of £7,000 for cables and services.

West Hartlepool.—An unopposed L.G.B. inquiry was held on May 2nd into the application of the T.C. for a loan of £7,070 for increasing the generating plant at the power station.

Whitehaven.—The T.C. has sanctioned an agreement to dispose of the E.L. undertaking to the Cumberland Electricity and Power Gas Co. for £25,000, the deal to be open to the company until 1910. If the company takes over the works before March 31st, 1910, energy is to be supplied for public lighting at 4d. per unit, and after that date at a rate not exceeding 3d. For private lighting the charge is not to exceed 4½d. per unit (the present charge made by the T.C.), or under the fixed charge at £8 per kw. per annum, and 2d. per unit. The agreement is contingent on the company obtaining the Act it is applying for.

Wolsingham.—The ratepayers have, on account of the initial cost (£2,500), rejected the proposed E.L. scheme submitted by the Weardale R.D.C., who proposed to take energy from the local steelworks.

Worcester.—The T.C. has adopted the following optional flat rate: Private lighting, including public houses, &c., 4½d. per unit; shops and places of worship, 5d.

A L.G.B. inquiry was held recently into an application by the T.C. for a loan of £5,850 for E.L. purposes. The Mayor stated that the sum included £5,567 excess expenditure. After going through the accounts, the inspector reduced the loan to £5,194, and at his suggestion a further loan of £2,600 for mains, house services and meters for the next three years was incorporated in the application. There was no opposition.

TRAMWAY and RAILWAY NOTES.

Adelaide.—The South Australian Government, after negotiations extending over two years, has mutually agreed with all the various tramway companies concerned upon the sum of £280,000 as the price at which their undertakings shall be handed over to the Government for the purpose of converting them to electric traction. This sum is subject to ratification by the State Parliament and the shareholders of the tramway concerns. The Premier has promised to secure the approval of the Legislature in the next session, and then to push on with electrification as speedily as possible. It is probable that the lines will be leased for the purpose of electrification either to the municipalities or to a private company. The horse-driven lines referred to are in the hands of five private companies, and have a single-track length of about 65 miles. The service and appearance of these out-of-date tramways has long been a sore grievance to the residents of Adelaide, who now look forward to a smarter and speedier system.

Ardrossan.—The Private Bill Commissioners last week resumed the consideration of the prov. order for the Ardrossan, Saltcoats and District Tramways. The total length of line is 11½ miles, and the population to be served numbered 21,000 in 1901. The local authorities supported the application.

Bournemouth.—The T.C. has resolved to give three months' notice to the Electricity Supply Co. for the reconsideration of the charges for electricity supply to the Poole section of tramways, and to refer certain claims preferred by the company under its agreement with the Poole Traction Co. to the arbitration of Prof. Kennedy.

Burton-upon-Trent.—The Tramways Committee having lately decided to increase the number of cars fitted with top-deck covers from three to six, the B. of T. has been approached with a view to obtaining its approval of the installation, the track gauge being 3 ft. 6 in. After some correspondence relating to the curves and gradients on the routes, the Board has intimated its approval of the use of covers, with the stipulation that the cars are to be withdrawn from service on any exposed section of the tramways on days when, owing to high winds, the risk of the cars being blown over may be anticipated.

The necessity of building up a reserve or renewals fund entirely apart from the annual contribution to the sinking fund for extinguishing the debt, has been recognised by the Tramways Committee, which decided, *before the results of the year's working were known*, to place to renewals fund the sum of £500 for this year, bringing this fund up to £1,945 7s. 11d. As there is only a surplus of £270 8s. 6d., this has necessitated shewing a deficit of £229 11s. 6d. The Committee is to be congratulated on its courageous refusal to declare a fictitious profit. In this respect its action compares most favourably with that of the L.C.C., which admits that 1d. per car-mile is an insufficient allowance, but has not even set aside that amount for depreciation, though it claims to have made a profit!

Canterbury-Herne Bay.—The B. of T. has issued an order reviving the powers granted under the Canterbury and Herne Bay Light Railway Order, and extending the period for the completion of the works.

Continental Notes.—Italy.—The report of the Commission appointed to inquire into the cost of electric traction on the Valtellina and Varese lines has recently been published. It appears

from the findings of the Commission that the cost of steam traction in 1897 amounted to 2,706 lire per train-kilometre, whereas in a similar period in 1903-4 the cost of electric traction amounted to 1,943 lire, or a reduction of 23 per cent., in spite of the fact that the trains drawn by electricity were considerably longer than those drawn by steam.

The Societa Anonima per Esercizio di Trazione Elettrica has been established at Milan with a capital of 200,000 lire, to be raised to 1,000,000 lire for the construction and exploitation of plants for electric traction in general and especially for electric traction at the Milan Exhibition.

La Societa Italiana di Industrie Elettrichi has applied for a concession to construct and work an electric tramway between Spezia and Pegazzano.

Croydon.—By an unfortunate confusion between ult. and inst., we stated last week that the Corporation took over the tramways at the end of last, instead of the current month. The lease expires on May 31st.

Dartford.—The U.D.C. on May 3rd decided to apply for powers to extend the electric tramways from Horn Cross to Swanscombe, so as to meet the Gravesend system.

Dudley.—The T.C. on May 2nd decided to apply to the B. of T. for a loan of £90,000 for the purchase of the tramways and light railways.

Finchley.—The U.D.C. has decided to support an appeal against a decision of the Divisional Court that light railways laid in public roads are liable to pay one-fourth only of the assessment to the general district rate.

London.—L.C.C.—The County Council on Tuesday adjourned for a week the consideration of the annual estimates of expenditure upon rate and revenue accounts for 1906-7, but Lord Welby, the chairman of the Finance Committee, delivered an explanatory speech. That portion of the chairman's speech in regard to the tramways is of sufficient interest to reproduce in full. It is as follows:—

On April 1st last the Council took over the northern tramways. We have before us the electrification of 50 miles on the south and 50 miles on the north, or a total length of about 100 miles, acquired from companies, and, in addition, about 20 miles of new lines which have already been authorised by Parliament.

The southern system has already cost us	£3,141,319	
We require to complete the south .. .. .. about	1,000,000	
		£4,141,319
The northern system has cost us	1,095,469	
We require to complete it .. .. say	3,500,000	
		4,595,469
The generating station at Greenwich has already cost us	390,080	
And we require to complete it	500,000	
		890,080
Sundry expenditure already incurred, not yet charged to either system because it is not yet revenue producing, amounts to		191,166
New lines authorised will cost		1,100,000
Making a total actual and estimated expenditure on authorised tramways		10,918,034
Or say		£11,000,000

The total debt already incurred up to March 31st last was £4,818,034, of which £607,231 has already been repaid, that is to say, one-eighth of the whole.

A sum of about £6,000,000 is required to complete the work of electrification. The Finance Committee agree that it is desirable to complete the work of electrification as soon as possible. But I would point out to the Council that this policy involves a heavy demand on the money market in the next two or three years. We are already paying a high price for our loans, and we shall have to pay a higher price in proportion as our loans are larger. May I venture to hope that the Council will bear this in mind, and will not entertain new schemes of expenditure until this great work approaches completion. As it has been expressed to me, will they "give their stock a little rest."

The working of the southern system in 1905-6, incomplete as it is, has been satisfactory, and I congratulate Mr. Allen Baker, chairman of the Highways Committee in that year, on the result. It is especially satisfactory to the Finance Committee as showing the care and moderation with which the estimate, under difficult circumstances, was framed. The receipts in 1905-6 were £57,000, and the expenditure £24,000, in excess of the original estimates, showing a net gain of £33,000. It enables us to increase the sum to be set aside for the renewals reserve account from £15,000 to £35,000, and to pay off £8,973 of the debt due on the Deptford temporary generating station.

These appropriations leave for 1905-6 a surplus on the southern system of	£4,165
The surplus on the northern system is	23,593
Total surplus	27,758
On the other hand, there is a deficiency on the general account of	24,735
Net surplus	£3,023

After putting aside sinking fund on the debt, appropriating £35,000 to the reserve fund, and paying off £8,973 of debt on a temporary station, we close 1905-6 practically in equilibrium.

For 1906-7 we estimate for a surplus on the southern system of £51,063, after setting aside £62,500 for renewals. This surplus will cover a deficit of £46,821 on the northern system and on general charges, leaving £4,242 to be added to balance carried forward. Thus we shall end again in practical equilibrium.

It is, of course, the duty of our opponents to search out the weak spots in our armour, but reasonable criticism will hardly expect more than equilibrium while these great changes are going on.

The Council will note the large amount which we propose to carry to the renewals fund, £62,500. We are anxious, as soon as possible, to raise the fund to the standard figure of 1d. per car-mile run. We anticipate that the renewals fund will amount to £169,000 on March 31st next, but it will need £40,000 or £50,000 more to make up the deficit on the penny in past years.

It is probable that 1d. per car-mile is somewhat less than the rate which it would be right to take as our standard, but 1½d. per car-mile would, we believe, be much in excess of the necessity of the case. This is a point which will have careful consideration as soon as the standard of 1d. per mile has been reached.

Metropolitan District Railway.—On Thursday last week an outbreak of fire occurred at the back of the rear carriage of a District train at St. Mary's, Whitechapel. The flames were extinguished with difficulty, and the train was subsequently shunted into the nearest siding. No one was injured.

New Romney.—As a guarantee for the *bona fides* of the promoters' intention to carry out the tramways scheme, Mr. Sellon has deposited £500 with the T.C. The scheme is to run an electric tramway from Folkestone, Sandgate, and Hythe, through Romney Marsh.

South Staffordshire.—The clerk to the Darlaston U.D.C. has been in communication with the B. of T. respecting a proposal to renew the licence to use electricity on the lines in the Council's district belonging to the South Staffordshire Tramways (Lessee) Co. An assurance has been given that the lines, although not in a satisfactory condition, are not dangerous, and that the work of renovation will be put in hand as soon as negotiations which are pending with the Walsall and Wednesbury Corporations are completed. As regards portions of the tramways within the borough of Walsall, the latter Corporation is under the terms of the lease responsible for all repairs. The B. of T. has under the circumstances renewed the licence. At the meeting of the U.D.C. last week the chairman expressed regret at the result of the correspondence, and expressed the opinion that any day might bring a serious accident owing to the state the lines were in.

Wakefield.—The Corporation is not satisfied with the result of the appeal against the decision of the Wakefield Justices as to the rating of the light railways in the city, and has decided to appeal against it, provided sufficient support is received from other local authorities concerned.

West Ham.—Application is to be made to the Board of Trade by the Corporation for sanction to the borrowing of £3,900 for tramway cables.

Weymouth.—A proposal is before the T.C. on behalf of the National Electric Construction Co., to install electric tramways in the borough, taking energy from the Corporation electricity works; the tramways to be on either the overhead or the Dolter surface contact system. A poll of the town is to be taken.

TELEGRAPH and TELEPHONE NOTES.

Brighton.—A L.G.B. inquiry will be held on Tuesday next relating to an application for power to borrow money for municipal telephones.

Cardiff.—The Telephones Committee of the T.C. last week considered tenders for the service for the new Town Hall and Law Courts, as follows:—National Telephone Co., for unlimited service, no charges to be made for removals, £880 15s.; for limited service (with message rate added), £773 5s. Post Office, for service partly unlimited and partly message rate, £1,212 6s. The National Telephone Co. asked leave to lay the wires underground, and offered to pay 5s. per wire annually, which meant about £300 for wayleave charges. The company's tender for unlimited service of £880 15s. was accepted, and the Committee agreed to permit the company to lay underground wires.

Colombo.—The following delightful extract is the work of a correspondent of the *Ceylon Standard*. It might be thought an excellent piece of humour, but we believe it is meant to be taken seriously:—"At last the Colombo telephone service bids fair to become what telephones were intended to be, a real convenience to those using them. Walking along the new routes in the Fort and elsewhere, one cannot help noticing the improvements and up-to-date class of work done by the English foreman, Mr. Lowett. On some routes, wires are run on the twist—left twist. They are cut at every span. Pulled up quite taut and terminated on double-groved [*sic*] insulators in ornamental style and the ends taken above the insulators and neatly twisted together, this joint requires no solder to ensure electrical contact. On other routes wires are run on bare wooden arms and tied round them where they terminate, thus doing away with the insulators which are only 'points' of leakage. Another advantage in this system is, that any number of wires could be put on a post, and all intending subscribers can be provided with immediate connections. It is further the safest method for wires erected over tramway wires having no glazed insulators from which wires could easily slip off. At subscriber's offices the india-rubber covered wires are run in a manner never before done. The pair of wires are neatly and firmly fixed along the wall, under one staple—and a large number of staples are used to prevent the

wires hanging loose—and presenting an unsightly appearance. The same system is adopted in joining wires or cross arms. Stays are now fixed overhead. A short pole is planted on the opposite side of the pole, and a stranded wire runs from it at a beautiful gradient to the pole requiring support. The public can now walk or ride past telephone posts without fear of tripping against stays. I hope, ere long to see further improvements effected, and trust that those mentioned above will relieve the minds of some people, who do not believe that Colombo will ever have a perfect telephone system."

Hull.—The first financial statement covering a full year's working of the municipal telephone service was submitted to the Corporation Telephone Committee last week. On revenue account there was an income of £7,234, and an expenditure of £4,371. Of the balance of £2,863, £1,451 (less £273 interest on current account) was applied to the payment of interest on loans. £1,109 was placed to suspense account as an instalment towards repayment of loan, and £100 was set aside as provision for bad and doubtful debts. A net balance was thus left of £476, which was reduced by the deficit of £73 on 1904-5 to £403. No amount was provided to cover depreciation. On capital account during the year £15,064 was expended, making, with £30,369 previously spent, a total of £45,434, and during the year £14,202 was further advanced by the Hull Savings Bank, making, with £29,000 previously advanced, a total of £43,202. This amount is repayable by 25 yearly instalments. The adverse balance on capital account is £2,232.

This report is quoted in the Press as "a profitable result."

Iceland.—The British Consul in Reykjavik reports that the contract for the establishment of a telegraph cable to Iceland signed with the Great Northern Telegraph Co. has been approved by the Icelandic Parliament (Althing), and is to come into operation in October next.

Morocco.—The fact that Germany obtained at the recent conference at Algeciras the right to land a cable in Morocco recalls the existence of four cables which connect Europe with Morocco, which latter country is said, with the exception of two short land-lines proceeding from Ceuta, to be entirely without telegraphic facilities at the present time. One of the four cables is British property and one is French, while the other two are Spanish; the latter unite Algeciras and Ceuta and Almeria and Melilla respectively, and are declared to be only of local importance. The cable of the Eastern Telegraph Co. was laid between Gibraltar and Tangier in 1887, the Spanish cables were established in 1891, and the French cable between Oran, Algeria and Tangier was laid in 1901. It is thought in German circles that it will not be necessary to wait very long before the proposed German cable is put in hand. A cable which was first brought into use at the end of 1896, already proceeds from Emden in the North Sea to the Spanish port of Vigo, the line having been laid for the purpose of securing connection with the English submarine cables on the Spanish coast. The Emden-Vigo cable is now in the hands of the German Atlantic Telegraph Co., and no difficulties are anticipated in extending it to Tangier, whilst at the same time the idea of making extensions to the southern ports of Morocco at a later date, is also entertained in Germany.

Pontypridd.—Inter-communication between the subscribers of the Post Office and the National Telephone Co. in the Pontypridd and Rhondda Valleys was effected last week.

The Post Office and Wireless Telegraphy.—A Parliamentary return just issued gives the heads of agreement between the Postmaster-General and Marconi's Wireless Telegraph Co., Ltd., and the Marconi International Marine Communication Co., Ltd., dated August 11th, 1904. The agreement guarantees facilities on the part of the Postmaster-General for a period of 15 years for the collection, transmission and delivery in the United Kingdom of messages to and from places in Newfoundland and North America, transmitted by Marconi apparatus installed at Poldhu and other stations to be agreed upon, such facilities to be substantially the same as were granted to the Submarine Cable Companies. Facilities to other countries were to be granted from time to time, provided that the Postmaster-General was satisfied that the companies were in a position to transmit and receive the messages with reasonable certainty and speed, and to secure the delivery of outward messages at their destination. Except in the case of Italy, such facilities would not be granted in respect of messages to or from the Continent of Europe.

During a period of eight years, the like facilities were granted for messages exchanged between ships and the several stations in the United Kingdom specified in the schedule attached, and such other stations in the United Kingdom as might be agreed upon.

In the event of any future grant by the Postmaster-General of facilities for the collection, transmission and delivery of messages in connection with wireless telegraph stations at which any system of wireless telegraphy other than the Marconi system is installed, the Postmaster-General would require the company or person owning or working such stations to observe suitable conditions with the object of securing non-interference with other wireless telegraph stations.

The companies were to accept in relation to their stations all such conditions as might be from time to time imposed under the preceding sub-clause, provided that such conditions should not unreasonably require the companies to change the position of any station, or to make any change in apparatus or arrangements which had already been adopted by them *bonâ fide* for the purpose of communication.

For the purpose of avoiding interference with Admiralty signalling the companies undertook to act in agreement with the Admiralty as to conditions of working.

His Majesty's Government were to have power to prohibit or control the working, or, if necessary, to take over the working, of any of the companies' stations in the event of any emergency, subject to payment of reasonable compensation to the companies under the same conditions as those prescribed in the landing licences granted to cable companies, and only British subjects were to be employed as operators at the companies' stations in the British dominions.

Messages of the British Government were to be transmitted with priority over all other messages, at rates not exceeding one-half of those charged to the public.

In the event of His Majesty's Government adhering to a Convention based substantially on the stipulations contained in the protocol of the Berlin Conference on Wireless Telegraphy, the companies undertook, if required, to observe in the United Kingdom and on British ships the provisions (except Art. VI) of the Convention, and in particular, if required by the Government, in relation to shore stations in the United Kingdom and ships equipped with Marconi apparatus for ship-and-shore messages, to accept the obligation to interchange messages with ships and shore stations in the United Kingdom respectively equipped with other apparatus, and to relieve the Admiralty and Lloyd's and all other persons with whom the companies had contracted, from any obligation arising under their contracts to refuse to interchange messages with ships or shore stations in the United Kingdom so equipped, or to make any compensation in respect of the interchange of such messages, provided that the companies shall be entitled to receive, until the end of seven years from the date of agreement, an additional rate in respect of every such message interchanged with another system, such additional rate not to exceed the rate allocated to the shore station.

In consideration of the advantages accruing to them under the agreement, the companies were to make no claim to compensation for or in respect of any interference with their business involved in or arising from the necessity of obtaining a licence or permission for the transaction of such business, or in respect of any other injury or damage to their interests due to legislation on the subject of wireless telegraphy, provided that the terms of the agreement were not thereby modified.

The schedule referred to includes the following stations: Lizard, Rosslare, Crookhaven (or Brow Head), Withernsea, Caister, Niton, Holyhead, North Foreland, Haven.

Post Office Telephone System.—According to the *Tribune*, at the present time 34,000 telephones are connected with the 14 Post Office exchanges which have already been established. Two of these exchanges were opened last year—one at Epsom, with a capacity for 250 subscribers, and the other at Ealing, with a capacity for 8,000 subscribers.

Arrangements have now been made for adding three more large common-battery exchanges, situate at Hornsey, Willesden Green and Finchley.

Smaller exchanges are likewise to be provided at Sutton, Harrow, Barnet, Esher, Kenley and Purley, and at Hounslow.

Arrangements have further been completed for giving Worcester Park and Kingsbury the benefit of the Post Office system.

Roumania.—The Austro-Hungarian Consul in Giurgevo, in a recent report, states that telephonic communication between the country towns and the centre of administration has greatly improved prevailing conditions; the extension of the system is estimated at 1,500 kilometres length of wire. The supply of electric cables, wire and other electrical apparatus, is keenly competed for by Austrian and German manufacturers.

Swansea.—On Tuesday last week, Mr. H. R. Hooper held a L.G.B. inquiry into an application of the T.C. for sanction to a loan of £7,000 to extend the telephone system. Evidence was given that the original scheme was for 750 lines, and the cost was to be £20,000, but since then £2,500 more had been sanctioned. On March 31st, 1,419 lines were working, and the total capital expenditure was £27,172. For the purpose of joining up new subscribers it was necessary to provide additional ducts and switchboards, &c., for another 350 subscribers, at a cost of £7,000. This work was absolutely necessary.

Under cross-examination by counsel on behalf of opposing ratepayers, the manager, Mr. Mackie, admitted that though a profit of £800 was claimed for the undertaking, no allowance had been made for depreciation. The Postmaster-General had offered only £17,000 for the undertaking, and the switchboard was of an obsolete pattern.

The Inspector pointed out that 14 miles of pole work and six sub-exchanges remained to be done, whilst none of the underground work under the present application had been carried out. £4,066 had already been expended out of £7,000 applied for, and interest had been paid out of revenue. The cost would be £30 2s. 6d. per line, and it was stated at the first inquiry that it would be £27, and less afterwards.

It transpired that the plan produced did not correspond with the particulars set out in the application; and that in the detailed estimates underground work was proposed, whereas overhead work had already been carried out on the same route. The Inspector complained of these variations, and said that they were very unfair to him, and the L.G.B. should have been informed of them. They had allowed to go in what they knew was false, as it had been altogether superseded.

The Town Clerk said he was equally surprised at the figures, and admitted that the inspector had serious cause of complaint.

The inquiry was adjourned *sine die*, pending the preparation of an amended plan and estimate.

Telegraphic Interruptions and Repairs :—

Cables.	Interrupted.	Repaired.
Trinidad-Demerara (No. 1.)	Aug. 26, 1901	..
Dominica-Martinique	May 7, 1902	..
St. Lucia-Martinique	May 7, 1902	..
Reissa-Issa (Yemen) Camaran	Oct. 22, 1902	..
Cayenne-Pinheiro	Aug. 13, 1902	..
Port Arthur-Chifu (Closed)	Mar. 7, 1904	..
Tarifa-Tangier	Jan. 18, 1904	..
Jamaica-Colon	Jan. 9, 1905	May 4
Tangier-Cadiz	Feb. 18, 1906	..
Cayenne-Paramaribo	April 20, 1906	..
Sydney-Nelson	April 26, 1906	..
Landlines.		
Puerto-Barrios	Aug. 28, 1902	..
Bachkale-Deliman	Feb. 12, 1906	..
Alep-Bagdad	April 27, 1906	April 30
Alep-Bagdad	May 2, 1906	May 6
Diarbekir-Bagdad	April 27, 1906	April 30
Diarbekir-Bagdad	May 2, 1906	May 6

Telephones in Rural Districts.—In last Friday's Parliamentary papers, Mr. H. H. Marks asks the Postmaster-General whether he can take steps to give effect to the recommendation of the Departmental Committee on the Fruit Industry that the telephone service should be further extended in country districts.—Mr. Sydney Buxton states that he has been in communication with the Board of Agriculture as to the best means of extending the telephone system in the fruit-growing districts, and the circumstances of particular districts are being investigated. In the last two years the Post Office has opened 127 exchanges in country districts, and a considerable number of others are being constructed. He hoped that the arrangement lately announced by the Chancellor of the Exchequer under which the Post Office will assume two-thirds of the liability under guarantees for the extension of the telephone trunk wire system will facilitate such extensions.

United States.—According to a recent report of the British Vice-Consul at San Diego, California, the Navy Bureau of Equipment is contemplating plans for the establishment of a wireless telegraph station at San Diego, and at several other points on the Pacific Coast.

Wireless Telegraphy.—The De Forest Wireless Telegraph Co. have opened an office at Seattle, with the reported intention of building a station at Cape Flattery at an early date, and another one further down the coast. Messages for transmission across the Pacific will be sent from San Francisco, *vid* the Hawaiian Islands, large installations being under construction at both points. A private company using the De Forest system, which has wireless telegraph stations at Mobile, Key West, Havana, Galveston and New Orleans, guarantee transmission of messages for 200 miles, and state that they have operated 1,100 miles. Their New Orleans station is on the top of the highest building there, and there is another station at the mouth of the River Mississippi. The United Fruit Co., of Boston, have at present wireless telegraph stations working at Limon, Boca del Toro and Bluefields, and intend erecting stations at Cuba, Jamaica, Florida, Cape Gracias, Nicaragua, Puerto Cortes, Honduras and Puerto Barrios, Guatemala, with the intention of connecting all their tropical divisions with the United States.—*The Times.*

The Lodge-Muirhead Wireless Telegraphy Syndicate will give a demonstration very shortly with a portable set of wireless apparatus designed for use with mounted troops. The military requirements are that each set should be an easy load for a second-class mule, and the complete set for one station is well within this limit. Each of these mobile stations is capable, without the use of kites or balloons for the suspension of its aerials, of communicating up to 40 miles on land and 100 miles across the sea.

CONTRACTS OPEN and CLOSED.

OPEN.

Accrington.—May 22nd. Lancashire boiler and generating plant for the electrical engineering department. See "Official Notices" to-day.

Bedford.—May 23rd. High and low tension cables for the Electricity Department. See "Official Notices" April 27th.

Belfast.—May 21st. Battery, boosters, balancers and switchgear for the Corporation. See "Official Notices" to-day.

Belgium.—May 16th. The Société des Chemins de fer Vicinaux, of Brussels, are calling for tenders for the installation of electric traction on the La Louviere-Haine-St. Pierre railway. Tenders are to be addressed to the offices of the above company, at 14, Rue de la Science, Brussels, by May 16th. A deposit of 20 per cent. of the value of the tender is required.

Belgium.—May 19th. The municipal authorities of Montigny-sur-Sambre are inviting tenders until the 19th inst. for the concession for the electric lighting of the town. Particulars may be obtained from, and tenders are to be sent to, L'Administration Communale de Montigny-sur-Sambre, Belgium.

Bermondsey.—May 18th. Condenser, cooling tower and arc lamp lowering gear. See "Official Notices" April 27th.

Bristol.—One 3,000-KW. three-phase turbo-alternator; one 500-KW. and two 300-KW. motor-generators; switchgear extensions; 30-ton electric crane; water-tube boilers; and considerable other plant for the Electricity Department. See "Official Notices" May 4th.

Carlisle.—May 24th. Traction battery, reversible booster and motor-driven balancer, for the Electricity Committee. See "Official Notices" to-day.

Chili.—June 16th. The municipal authorities of Iquique are inviting tenders until June 16th for the electric lighting of the town and public buildings.

Coventry.—May 24th. Lancashire boilers, economiser, piping, mechanical stoker, three alternators (two of 600-KW. and one of 300-KW.), and two-phase motors, for the Corporation. See "Official Notices" to-day.

Croydon.—May 16th. Overhead equipment of Whitehorse Road Tramways for the Corporation. See "Official Notices" May 4th.

Edinburgh.—May 14th. Arc lamp-posts for the Corporation. See "Official Notices" April 27th.

Edinburgh.—May 14th. Street lighting arc lamps for the Corporation. See "Official Notices" May 4th.

Fulham.—May 23rd. Sub-station equipment for the electricity department. See "Official Notices" to-day.

Govan.—May 30th. Stores for the electricity department. See "Official Notices" April 20th.

Johannesburg.—June 16th. Three electric watering cars for use on the Council's tramways. See "Official Notices" May 4th.

Leek.—May 14th. Gas dynamo for the U.D.C. See "Official Notices" April 27th.

Rotherham.—May 17th. Advertising rights on the Corporation electric cars. See "Official Notices" April 27th.

Rotherham.—May 21st. Steel rails, fish-plates, tie-bars' trolley wire, bracket arms, &c., for the Tramways Committee. See "Official Notices" to-day.

Salford.—May 12th. Tramway feeder boosters, &c., for sub-station. See "Official Notices" April 20th.

Spain.—The municipal authorities of Banobarez (province of Salamanca) have just invited tenders for the concession for the electric lighting of the town during a period of 10 years.

Stoke-upon-Trent.—May 20th. Steam dynamo, condensing plant, boosters and balancer, for the electricity department. See "Official Notices" April 27th.

Swansea.—May 29th. One 600-KW. C.C. steam generator with condensing plant, piping, &c., for the Corporation. See "Official Notices" May 4th.

Worthing.—May 28th. Gas engine and producer plant for the Corporation electricity works. See "Official Notices" to-day.

CLOSED.

Belfast.—The contract for steam dynamos and another engine for the Tramways and Electricity Committee has been given to Messrs. Combe, Barbour, Ltd. Their tender was not actually the lowest, but the Committee reported that, taking everything into consideration, it felt itself justified in placing the contract with them.

Blackpool.—The Victoria Pier Co. have decided to adopt flame lamps for lighting the pier this summer, and they have placed the order for the lamps ("Excello" type), with Messrs. Baxendale and Co., of Manchester.

Bradford.—The Corporation has accepted an offer of Messrs. Ferranti, Ltd., to supply 400 electricity meters of the new type on condition that the firm take back a similar number of obsolete Ferranti meters and make an allowance of £1 per meter.

Brighton.—The T.C. on May 3rd accepted the tender of the Zurich Incandescent Lamp Co. for the ensuing year's supply of incandescent lamps, at 8¼d. each.

Canterbury.—The T.C. has accepted the tender of Messrs. Chamberlain & Hookham for the supply of electricity meters for the ensuing year.

Cardiff.—The T.C. on Friday accepted the tender of the National Telephone Co. for an unlimited telephone service, at £881 per annum. The Post Office tendered at £1,212 for a service partly unlimited and partly at message rate.

Gillingham (Kent).—The T.C. has accepted the following tenders for supplies to the electricity works:—The Electrical Co., Ltd., and Messrs. Mordey, Fricker & Co., Ltd., for meters, &c., and Messrs. W. H. Willcox & Co., Ltd., for oils.

Halifax.—The Corporation has placed an order with Messrs. Legros & Knowles, Ltd., of Cumberland Park, Willesden Junction, for a petrol motor tower wagon for tramway purposes.

Hull.—The Telephone Committee of the T.C. has accepted the tender of the Land and Sea Cable Co. for the supply of cables, at £390, and that of the Ericsson Bell Telephone Co. for the extension of the switchboard, at £447.

Lewisham.—The B.C. has received the following tenders for two single-phase electric motors for driving chaff-cutting and corn-crushing machines:—

UNENCLOSED MOTORS.

British Thomson-Houston Co., Ltd.	£136
General Electric Co., Ltd.	120
British Westinghouse Co., Ltd.	140

ENCLOSED.

British Thomson-Houston Co., Ltd. .. (accepted)	£156

Leyton.—The U.D.C. has accepted the tender of Mr. W. Manders, of Leyton, for the construction of car-sheds and repair shops, at £12,178, and that of Messrs. Dorman, Long & Co., Ltd, for roof trusses, at £2,733. For the latter 32 tenders were sent in, the highest being £4,085 6s., and for the former 14, the highest being £14,948.

London.—BATTERSEA.—The B.C. has accepted the following tenders in connection with the electricity undertaking:—

Gilbert Arc Lamp Co., Ltd., 20 arc lamp globes, 8s. 6d. each.
Babcock & Wilcox, Ltd., two self-recording steel tube mercury thermometers with capillary, wire and necessary containers, £29.

MARYLEBONE.—The B.C. has accepted an offer from the St. Helens Cable Co., Ltd., to sell to the Council a quantity of cable, manufactured by them for the purposes of their contract with the Council, but which was in excess of what was required for the distribution system. The price is as follows:—1,637 yards of ·5 armoured cable, at £606 18s. per mile = £564 9s. 8d.; 316 yards of 1 sq. in. lead-covered cable, at £184 5s. 3d. per mile = £230 11s. 7d.; 98 yards of 5-core pilot cable, at £150 11s. 1d. per mile = £8 17s. 7d.

SOUTHWARK.—The B.C. received the following tenders to supply two circuit breakers for the feeder switchboard:—

Geipel & Lange, Ltd.	£117
General Electric Co., Ltd.	96
Switchgear Co., Ltd. .. .. (accepted)	41

Salford.—The T.C. on May 2nd accepted the tender of Thermit, Ltd., of London, for the supply of 500 welding portions of tramway rails, at 20s. each.

South Africa.—The Natal Government Railways have decided to put down a modern electrical generating station at their Durban works, and the complete contract for the turbo-alternators and surface condensing plant has been placed in the hands of Messrs. Willans & Robinson, Ltd, of Rugby, who are manufacturing the plant for Messrs. Hubert, Davies & Spain, the main contractors to the Natal Government Railways.

York.—The T.C. has accepted the tender of Messrs. Cox-Walkers, of Darlington, for the provision of telephones, fire alarms and tell-tale indicators at Naburn Asylum, at £513.

FORTHCOMING EVENTS.

To-day's Events (Friday, May 11th).—At 8 p.m. Junior Institution of Engineers. Mr. A. Hunter on "The Structural Design of Factories."

At 8 p.m. Physical Society. Mr. A. Russell on "The Effect of a Rapid Discharge on the Throw of a Galvanometer." Exhibition of Lippmann Capillary Dynamo and Electromotor, by Prof. H. A. Wilson. Exhibition of an Apparatus for Demonstrating the Movements of the Diaphragms of Telephonic Transmitters and Receivers and the Current Flowing into and out of the Cable during Speech.

At 8 p.m. Association of Engineers-in-Charge. Annual meeting.

Saturday, May 12th.—At 2.30 p.m. I.E.E. (Students) visit to Messrs. Napier's Motor Works at Acton.

I.E.E. (Leeds) visit to the Electricity and Tramway Power Stations. Meet Whitehall Road Works at 3 p.m.

Monday, May 14th.—I.Mech.E. (Graduates). Mr. M. W. Ward on "The Construction of the Blast Furnace."

Wednesday, May 16th.—At 7.30 p.m. I.E.E. (Students) Annual General Meeting. Mr. J. W. Fraser on "Sub-station Equipment."

Thursday, May 17th.—At 8 p.m. I.E.E. Extraordinary Meeting at Society of Arts. Messrs. R. N. Tweedy and H. Dudgeon on "Notes on Overhead Equipment of Tramways" (read at Birmingham on February 14th).

At 8.30 p.m. Chemical Society Meeting.

Friday, May 18th.—N.E. Coast Institution of Engineers and Shipbuilders. Closing business meeting, at Newcastle.

At 9 p.m. Royal Institution. Prof. A. Schuster on "International Science."

Saturday, May 19th.—At 3 p.m. Royal Institution. Prof. Sir J. Dewar on "The Old and New Chemistry." (Lecture I.)

THE ELECTRICAL ENGINEERS R.E. (VOLS.).

THE following orders are issued:—

Monday, May 14th.—"A" Company, infantry drill, 7 p.m.; practice Tournament, 9 p.m.

Tuesday, May 15th.—"B" Company, drill competition, 8 p.m.; practice Tournament, 9 p.m.; medical examination, 7 p.m.

Wednesday, May 16th.—Detachments for Tournament, full dress parade, headquarters, 7 p.m.

Thursday, May 17th.—"C" Company, drill competition, 8 p.m.; practice Tournament, 9 p.m.

Friday, May 18th.—"D" Company, drill competition, 7 p.m.; practice Tournament, 9 p.m.

Saturday, May 19th.—Route march, parade Millbank Barracks, at 4.30 p.m. Inspection by Chief Engineer London District, 4.45 p.m.

J. H. S. PHILLIPS, Captain.
For O.C.E.E.R.E. (V.).

NOTES.

Producer-Gas Power in Electric Stations.—In an article by Dr. Oskar Nagel in the New York *Electrical World*, it is stated:—"In Germany and Austria a considerable number of gas engines and gas producers, especially of the Koerting type, are in successful use for municipal electric light plants and electric stations in public buildings, depôts, post offices, &c. Several years of experience have shown that such gas power plant is fully as reliable as the best steam plant, and has the advantage of much greater economy. The slow speed and heavy construction of the Koerting engine make this machine absolutely reliable, the extremely sensitive governor gives close regulation, and the Koerting mixing valve ensures greatest economy.

"In the accompanying table are given some figures from actual practice of several German plants. It must be borne in mind, if comparison is made with steam plants, that the gas plants referred to are of small size, and are working only a relatively short time every day, so that the average load is rather low, and the stand-by losses considerable. If all these points are taken into consideration, it

GAS ENGINE PRODUCER CENTRAL STATIONS, 1902-3.
KOERTING ENGINES AND PRODUCERS.

Place.	KW.-hours.		KW.-hrs. per 1 lb. coal.		Lubricating oil, total per year (lb.)	Cotton waste gm. per KW.-hour.	H.P. capacity.
	Gen'd.	Deliv'd.	Gen'd.	Deliv'd.			
Clausthal ..	219,150	195,943	0·36	0·33	2,708	—	100
Gransee ..	51,847	44,748	0·36	0·31	640	0·558	100
Neumarkt ..	125,076	98,711	0·37	0·3	1,984	0·442	80
Neurode ..	119,800	94,731	0·24	0·21	798	1·42	160
Reichenbach..	49,437	45,418	0·3	0·27	673	0·500	60
Soberheim ..	95,328	80,600	0·36	—	1,540	3·50	100
Schoenberg ..	58,514	46,638	0·35	0·29	1,654	1·3	80
Schwetz ..	82,312	67,072	0·398	0·33	880	1·06	160
Walserorde ..	60,352	53,940	0·32	0·29	1,086	2·03	70
Wienenden .. *Post Office.*	71,828	—	0·24	—	1,102	1·98	160
Karlsruhe .. *Depôt.*	70,766	61,693	0·45	0·39	798	1·08	100
Werdan ..	102,716	92,607	0·36	0·32	1,375	2·99	90

will be found that the total coal consumption per KW.-hour is extremely low. The cost of lubricating oil is not higher than in a steam plant, and the cost of attendance is considerably lower.

In Pressburg, Hungary, a 125-H.P. Koerting gas power plant is running in the electric central station according to a guarantee of 1·4 lb. of furnace coke per H.P.-hour at full load, and 1·7 lb. at half load. During a test of 8 hours, 1 KW.-hour was developed from 0·25 lb. less coke than the guaranteed consumption."

Results of a Trackless Trolley Trial in Germany.—The *Street Railway Journal* gives some facts and figures regarding a series of experiments with a trackless trolley system recently concluded at Eberswalde, Germany. It was found that the average consumption of energy, including transmission losses, was 660 watt-hours per omnibus-kilometre. The weight of the vehicle was 3,400 kg. (7,496 lb.); energy consumption per ton (2,204 lb.) 153 watts; and maximum speed per hour, 14 km. The costs of the installation, owing to unusual conditions, were exceptionally high. The estimated cost of an automobile trolley line 3·1 miles in length, under ordinary circumstances, is as follows:—Electric line, $9,650; two cars, $6,948; car depôt, $2,702; total, $19,300. The estimated annual cost of operating the above-mentioned line on the basis of 30,000 car-km. annually, the cost of current furnished by the central station being 4·82½ cents per kw.-hour, is $1,737. Counting upon receipts of $3,088, or £617.60 per km., the net profit will be $1,351, or 7 per cent. of the capital invested. The fare charged was 2·38 cents per person. The road at Eberswalde was in operation for a little over five months, when, owing to the unusual costs of construction and of operating and keeping the line in repair, it was withdrawn by the company.

Electric v. Gas Lighting.—The *Electrical Contractor*, the official organ of the Electrical Contractors' Association, Incorporated, is offering a prize of £5 for the best essay of 1,500 to 3,000 words upon the above subject. Competitions have to be sent in before June 11th.

(*Continued on page* 766.)

THE DUNDEE, BROUGHTY FERRY AND DISTRICT TRAMWAYS.

This system of tramways which was recently inaugurated connects Dundee with Broughty Ferry and Monifieth.

Fig. 1.—The Power House and Car Shed.

Dundee, the third largest city in Scotland, is charmingly situated on the north bank of the River Tay, and is the seat of several important industries, chief among which are jute and linen; there are also large engineering shops and shipbuilding yards. One mile eastwards of the Dundee boundary begins the boundary of Broughty Ferry, which has now developed into a residential town, extending 3½ miles along the seashore and back into the hills. To the east of Broughty Ferry lies the burgh of Monifieth, which possesses one of the finest golf courses to be found in Scotland.

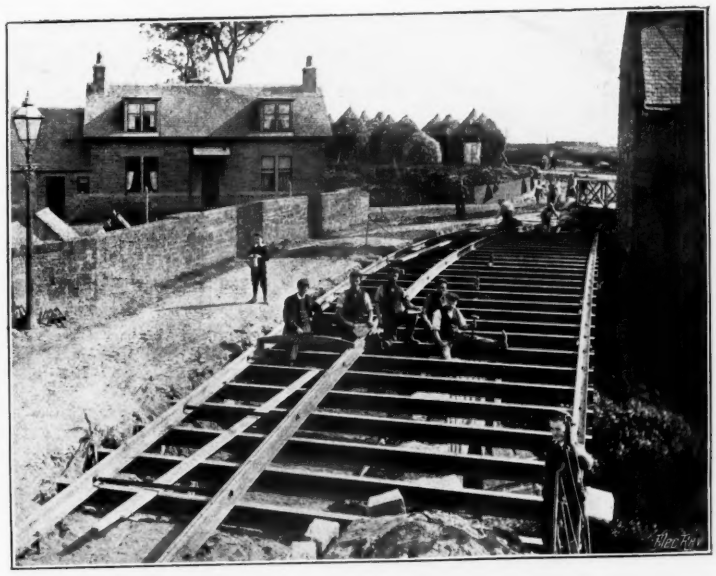


Fig. 2.—Widening the Bridge over Dighty Water.

An attempt at joining up the above-mentioned places by means of tramways was first made so long ago as 1872, when the Dundee Tramways Act was passed, but the powers conferred by the Act were allowed to lapse. The existing tramways in Dundee were first commenced as horse tramways in 1878, and were worked by a company, but by the Dundee Corporation Tramways Act of 1898, the lines were taken over by the Corporation and electrified.

The present Light Railways Bill, after favourable concessions had been obtained from the local authorities and landowners, was promoted in the spring of 1903 by Mr. George Balfour, and was duly passed and sanctioned in the same year.

The total length of route of the present system is about 5½ miles, 4¼ of which are double track, giving 9¾ miles of single track. It starts with a physical junction with the Dundee Corporation Tramways at the extreme eastern boundary of Dundee. For the first 600 yards it runs along a country road, and then branching off to the left, runs for ¾ mile on a private road, specially constructed for the purpose, through parks on the Craigie and Home Estates, again joining the public road at the Broughty Ferry boundary. Continuing through the latter place, the line terminates at Monifieth. By an arrangement with the Dundee Corporation, the cars run over the Corporation lines to the centre of the city; by this means passengers from the outlying districts can reach the business portion of Dundee as quickly as with the railroad, but with far less inconvenience to themselves. This facility and the attractiveness of the district traversed by the company's line give every assurance for the financial success of the undertaking.

The rails are of No. 1 British Standard section, weighing 90 lb. to the yard, with 96 lb. rails on curves of short radius. The sharpest curve has a radius of 30 ft. At the joints continuous rail joints are employed in lieu of the more usual fishplates and the rails are anchored every 22 ft. The bonding is double with concealed bonds of 0000 section. The points and crossings were supplied by Messrs. Edgar Allen & Co.,

Fig. 3.—Private Tramway over the Home and Craigie Estates.

Sheffield. For the paving Aberdeen granite and Whinstone setts were used. The private road before mentioned was made 50 ft. wide, and instead of Whinstone setts, tar macadam was laid. This road is fenced on both sides, and the cars are allowed by the Board of Trade to run at a speed of 15 miles per hour. The bridge over the Dighty Water, near Monifieth, was widened by passing steel girders under the track. These girders are embedded in concrete, and acting as cantilevers support the footpath on each side.

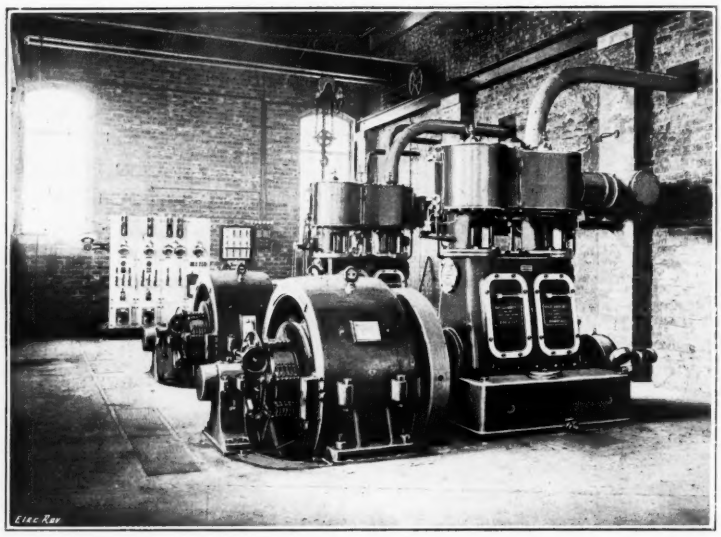


Fig. 4.—View of Engine Room, Showing Belliss-Bruce Peebles Generating Plant.

The overhead equipment is the standard side-running bracket-arm suspension with double trolley wire and flexible suspension.

The cables were supplied by Messrs. Henley, and are paper-insulated, lead-covered, and laid solid in wooden troughs.

The power house is situated on the banks of the Dighty Water, from which, by means of a pipe 150 ft. long, the supply of condensing water is obtained. The feed water is taken from the Dundee water supply. At the rear of the power house is a coal store 21 ft. × 21 ft. The chimney, which was built by the Ferbeck Co., is 110 ft. high, with an interior diameter of 5 ft. The flooring in both engine and boiler rooms is of concrete.

There are three Lancashire boilers 25 ft. long, and 7 ft. 6 in. in diameter, supplied by the Carmichael Ward Foundry, of Dundee. The working pressure is 150 lb. per sq. in., and each boiler is capable of evaporating 4,600 lb. of water per hour at normal rating. At the back of each boiler there is a Sugden superheater, provided with a bye-pass; each superheater is capable of superheating 5,000 lb. of steam per hour 150° F., at the boiler pressure. There are two Worthington steam-driven feed pumps, each capable of delivering 1,400 gals. of water per hour to the boilers. The feed water heater was supplied by the Wheeler Condenser Co.; it has 150 sq. ft. of heating surface, and with the exhaust steam from the auxiliary plant will heat 2,000 gals. per hour from 70° to 200° F. The water discharged from the condenser is purified by a Harris-Anderson purifier, handling 1,400 gals. per hour. The condenser is of the surface type by the Worthington Co., and is operated by a Blake-Knowles combined air and circulating pump. The condenser is specified to deal with 9,000 lb. of steam per hour, maintaining a vacuum of 26 in. The pipework was supplied by Messrs. Babcock and Wilcox, Ltd.

The generating plant comprises two Belliss-Bruce Peebles 200-kw. traction sets, running at 400 r.p.m. The switchboard was supplied by Messrs. Ferranti, and consists of two generators, one feeder and one B. of T. panel.

The lighting can be taken from the switchboard or be supplied by a separate Willans' unit.

The engine room is fitted with a hand travelling crane, with a 25-ft. span to lift 8 tons, supplied by Messrs. James Carrick & Son.

The car-shed, which is situated at Milton, about ½ mile from Monifieth and about 100 yds. from the main road, is a brick building provided with the usual inspection pits, 221 ft. long × 36 ft. wide. One end of the shed is occupied by repair and paint shops, store room and smithy. The three doors are fitted with Kinnear steel rolling shutters, with their patent trolley-wire attachment.

The car-shed fan is made with Vignole rails running on sleepers with needle points and built-up crossings. The offices are in a separate building, and contain rooms for the manager, clerks and conductors.

The cars, 12 in number, were supplied by the British Thomson-Houston Co., and are fitted with their electrical equipments, the two motors being each capable of giving 1,300 lb. draw-bar pull at a car speed of 10 miles per hour. The bodies and trucks are of the Brush Co.'s manufacture. All the cars are fitted with hand, electric and track slipper-brakes. The lifeguards are of the Dundee pattern, which are of the drop-gate type, a special feature being that the guard is set at an angle with the track, an arrangement whereby obstacles are thrown clear of the car.

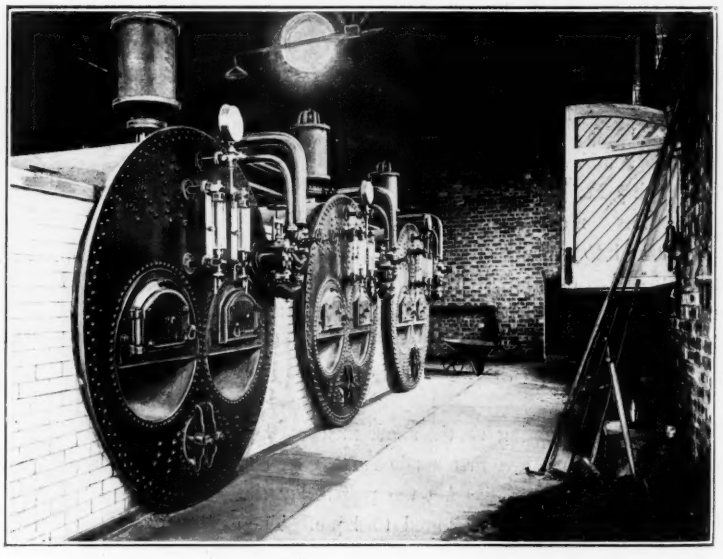
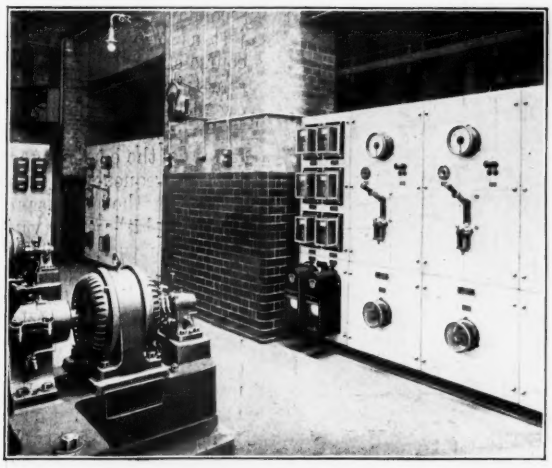


Fig. 5.—The Boiler House.

Messrs. J. G. White & Co., Ltd., who have been specially identified with tramway constructional work during recent years, held the contract for the whole of the Dundee, Broughty Ferry and District Tramways system described above.

ELECTRICITY SUPPLY IN STOKE NEWINGTON.

The Stoke Newington Borough Council's new electricity supply undertaking is interesting as the first instance of a Metropolitan Borough Council discarding the time-honoured practice of installing a small and inefficient generating station of its own, and adopting the more modern and economical method of taking energy in bulk from one of the great electrical supply undertakings. In adopting this course, moreover, the Stoke Newington Borough Council has been able to safeguard its own interests in the most thorough manner, since its agreement with the North Metropolitan Electric Supply Co. provides that the Power Co. shall guarantee the whole of the undertaking for three years, paying interest and sinking fund charges and also a sum for depreciation (which will be fixed by the L.C.C.), this sum to be refunded should the borough exercise its power to take over the undertaking at the end of three years. The arrangement, in short, is that while the borough provides the capital cost of the undertaking, the company bears all expenses of running and maintenance for three years, and in return receives the revenue. At the end of three years the Borough Council can either take the undertaking over, or leave it in the hands of the Power Co., as may be thought expedient.

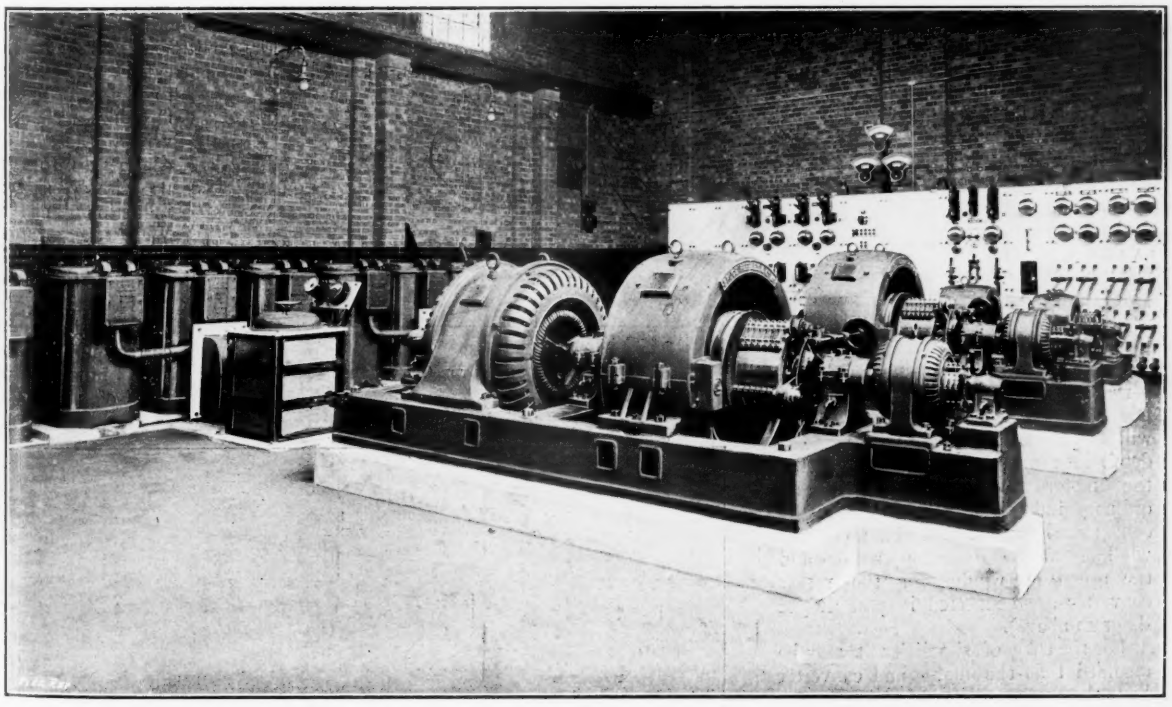


Feeder and Transformer Switchboards.

Hitherto public electricity supply in Stoke Newington has been derived from the Hackney electricity works, and has been confined to the western side of High Street, the eastern side of which is situated within the Borough of Hackney; the supply was, and is, used for public lighting and for frontage consumers, amounting in all to 100,000 units per annum. This arrangement will shortly lapse, and the supply will be given from the new sub-station, which will therefore have the advantage of starting with a fairly good load.

The sub-station plant has been built throughout to the design of the consulting engineers, Messrs. Talbot and Stevenson. Inquiries were, in the first instance, made for induction motor-generators, each consisting of one induction motor driving two D.C. generators, one for each side of the 3-wire system. Various tenders were received on this basis, the lowest amounting to about £2,000 with a guaranteed overall efficiency of 78½ per cent. at full load, and 76 per cent. at half load. Messrs. Bruce Peebles, however, submitted an alternative tender for Peebles-La Cour motor-converters with much higher guarantees of efficiency, and after full investigation on the part of Mr. Stevenson this tender was accepted.

The two sets now installed are each of 120-KW. capacity, and consist each of three machines: motor, converter and booster. As is now well known, the motor-converter shares with the rotary converter the advantage of being able to operate on the three-wire system without auxiliary balancers, the neutral being connected to the star point of the rotor winding. In this way a large out-of-balance current can be taken care of without auxiliary plant, but as in the case of the Stoke Newington machines the out-of-balance currents likely to be met with reached exceptional dimensions, it was thought advisable to insert between the neutral



Interior of Sub-station: Peebles-La Cour Motor-Converters and Ferranti Transformers.

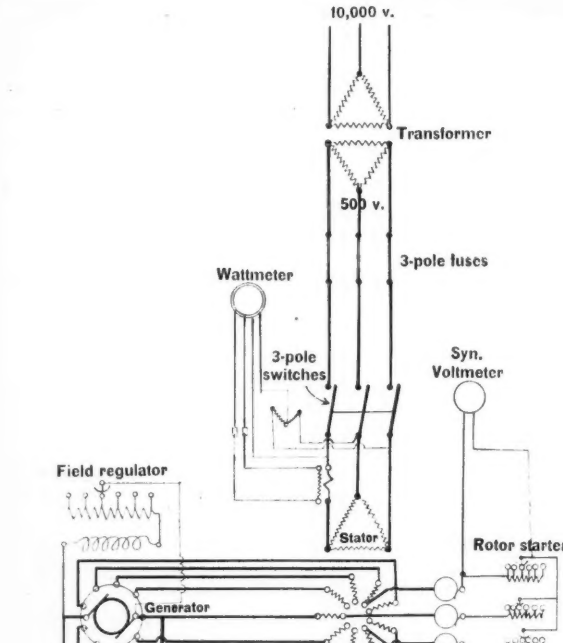


Diagram of Connections.

and the star point of the rotor winding a small reversible booster capable of boosting a current of 125 amperes in the neutral wire through a voltage range of 12 volts up or down.

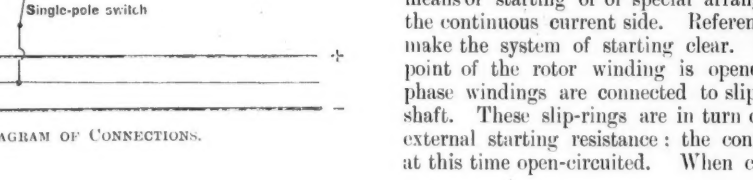
As the operating principle of the Peebles - La Cour motor-converter is, perhaps, not yet familiar to the majority of our readers, it will be as well for us to go into some detail in connection with this. Briefly, the motor-converter consists of an ordinary induction motor and a rotary converter rigidly coupled. The secondary winding of the induction motor and the armature winding of the rotary converter are connected in parallel (see diagram above).

For the sake of simplicity it may be assumed that the motor and converter have the same number of poles (in the case shown in the diagram two poles), and that the rotor and armature rotate at a speed corresponding to half the frequency of the primary circuit; thus the rotating field induced in the rotor by the primary circuit rotates relatively to the rotor at a speed corresponding to half the frequency of the supply circuit, and, therefore, induces in the rotor windings an E.M.F. also of half the frequency of the supply circuit.

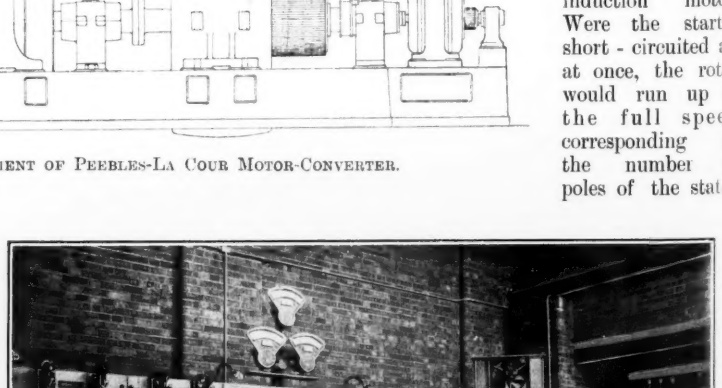
Now it is obvious that the direct-current armature being mechanically driven in a field having a certain number of poles will generate alternating currents at a certain frequency, these being converted into direct current by passing the commutator.

Obviously, moreover, this frequency will be the same as that of the current which passes into the armature from the secondary winding of the induction motor. As a consequence, the armature of the direct current machine and the secondary winding of the induction motor may be paralleled just as two ordinary alternators. This paralleling is of course effected by the connections between the rotor and armature above referred to. Further, it will be seen that once paralleled, the rotor and armature must continue to run synchronously, as should the speed increase, then the frequency of the currents generated in the armature will increase, but the frequency of the currents generated in the rotor will decrease, as the latter is proportional to the slip of the induction motor, and therefore varies inversely as the speed. Synchronising currents would then flow, just as such currents flow between two alternators, and the armature and rotor would be pulled into parallel again by these currents. A similar but opposite cycle of operations would obviously take place were the speed reduced. Thus evidently the motor-converter is a synchronous machine, and it is, further, much more stable in parallel than an ordinary three-phase machine, for the reason that the rotor and armature are wound nine-phase or twelve-phase instead of three-phase only, and the windings being thus connected at a much larger number of points, the synchronising force is very much greater.

Although the motor-converter runs as a synchronous machine, it has the great advantage of starting up as an induction motor, without the necessity for any external means of starting or of special arrangements to start from the continuous current side. Reference to the diagram will make the system of starting clear. On starting, the star point of the rotor winding is opened, and three of the phase windings are connected to slip-rings mounted on the shaft. These slip-rings are in turn connected to a suitable external starting resistance: the continuous current end is at this time open-circuited. When current is switched on to the primary of the motor-converter, the motor commences to run up simply as an induction motor. Were the starter short-circuited all at once, the rotor would run up to the full speed corresponding to the number of poles of the stator



Arrangement of Peebles-La Cour Motor-Converter.



Direct-Current Generator and Feeder Switchboard.

winding. This, however, is not done, a portion of the resistance being kept in circuit so that the rotor slip is large and the speed correspondingly low. In the meantime the D.C. machine becomes self-excited, and the converter speeds up until the two E.M.F.'s induced in the armature and rotor respectively synchronise themselves. After this, of course, the machine will not rise to a higher speed, being prevented by the synchronising force, in the manner above explained. Up to the moment of synchronism, large currents out of phase with each other have been flowing in the winding, being only held in check by the resistance in circuit. As soon, however, as the E.M.F.'s are in synchronism, they oppose each other, and the resultant E.M.F. is very small, giving rise only to a small current. The inner points of the phase windings on the rotor are carried out to a manually operated short-circuiter beside the slip-rings. When the short-circuiter is opened, three of the phase windings are connected up to the three slip-rings, but when the short-circuiter is closed the effect is to short-circuit all the inner ends of the phase windings on the rotor—in other words, to close the star point of the secondary winding; when this star point is closed, the machine is, of course, cut into parallel. The exact moment at which it should be closed is indicated by a voltmeter connected across part of the starting resistance. As long as large out-of-phase rotor currents are flowing, this voltmeter will give a high and fluctuating reading, as, of course, the different electromotive forces will be at one moment helping each other and at another moment opposing each other. As soon, however, as the current falls and the machine reaches synchronous speed the voltmeter reading comes nearly to zero and stands steady, and at this moment the short-circuiter is pushed home and the converter synchronised; the time taken for synchronising from rest in the case of the Stoke Newington machines is about one minute.

An important advantage of the La Cour motor-converter is that it is adapted for running on very much higher frequencies than is the rotary converter; it will be seen that in the two-pole case which we have above referred to, the frequency of the currents which are transmitted to the continuous-current armature is only half the primary frequency, and by choosing different ratios between the numbers of poles in the induction motor and the converter, this frequency could be still further reduced in proportion; thus it would be as easy to build a motor-converter for 100 periods as to build a rotary converter for 50 periods, while the 50-period motor-converter is as satisfactory a machine in every respect as a 25-period rotary.

The motor-converter has the further advantage of being a much simpler machine in operation than a rotary, being much more stable in parallel and requiring less auxiliary starting gear, &c. In large units transformers are unnecessary, and the stator of the induction motor is wound for high tension. A number of 250 and 500-KW. sets have already been constructed and are in operation on 10,000-volt circuits. In the case of the Stoke Newington machines, however, the advantage of putting high tension direct on the stator would be neutralised by the difficulty of winding so small a machine for such high voltage, so that in this case transformers are provided for stepping down the 10,000-volt supply to 500 volts for the motor.

As compared with motor-generators, the La Cour converter holds considerable advantages in efficiency, and in suitability for three-wire connection, while almost any required degree of voltage regulation on the continuous-current end is possible. In the case of three 500-KW. machines now running at the Dickinson Street Station of the Manchester Corporation, the variation is from 400 to 550 volts. This result is, moreover, attained without detriment to the power factor of the system, being secured simply by field regulation of the continuous-current end, and not by the use of choking coils in the alternating-current supply.

The Stoke Newington machines are each of 120-KW. output, supplying direct current to the outers at 480-520 volts. The temperature rise after 10 hours' full load run is 70° F. for the direct-current machine, and 80° F. for the alternating-current machine. The overload capacity is 50 per cent. for half-an-hour at the end of 10 hours' full load run.

The station is fed from the Wood Green sub-station of the North Metropolitan Electric Supply Co., three miles away, through two feeders, each having three cores of 0·1 sq. in. cross-section, at 10,000 volts. These cables are of the lead-covered paper-insulated type, and were supplied and laid by Messrs. The British Insulated and Helsby Cables, Ltd.

The feeders terminate in brick compartments behind the high-pressure switchboard, where the currents are led through disconnecting switches, Ferranti oil-tank switches with reverse-current relays, and a second set of disconnecting switches, to the bus-bars, which are carried overhead on insulators. Watt-hour meters in triplicate, connected with current and pressure transformers in circuit with the bus-bars, are mounted on the high-pressure switchboard to record the energy supplied to the station. The transformers are connected with the bus-bars through switchgear similar to the feeder switchgear, with the exception that the oil-switches are equipped with overload time-limit relays instead of reverse-current relays. The transformer cables are provided with extra heavy insulation of rubber and compound, and arrangements are made for drawing warm air through the cable ducts when necessary.

The transformers, which were supplied by Messrs. Ferranti, Ltd., as sub-contractors, are of the oil-cooled type, each having an output of 47 KW. and a full load efficiency of 97·8 per cent.

The battery consists of 244 cells of the Electric Power Storage Co.'s make, having a discharge capacity of 100 amperes for five hours, or 250 amperes for one hour.

There is sufficient space in the present building to accommodate two additional 300-KW. sets and a second battery of equal size before extensions become necessary, for which the site affords ample room.

The plant supplied by Messrs. Bruce Peebles includes a reversible battery booster, consisting of three Peebles standard direct-current machines, direct coupled on a combined bed-plate with the motor in the middle. The boosters are fitted with laminated poles, and give an output of 100 amperes at any voltage from 3 to 90 as a charging output, and 220 amperes at any voltage up to 40 as a discharge output; the motor runs on the outers at 480-500 volts. The regulation and reversal is carried out by the fall of potential method, so that zero potential may be obtained when reversing the field. Messrs. Bruce Peebles are also to supply a milking booster, consisting of two machines directly coupled on a combined bed-plate, the generator developing 70 amperes at 4 to 12 volts. This machine, however, is not yet in place.

The outgoing feeders to the D.C. distributors are at present four in number; with the generators they are controlled by a switchboard supplied by Messrs. Ferranti, Ltd., and shown in one of our views. This board is equipped with the usual switchgear, including reverse-current relays on the generator leads. The low-tension cable system has been supplied and laid by Messrs. Henley's Telegraph Works Co., Ltd.; both feeders and distributors are insulated with paper and lead sheathed, and are laid solid in troughs.

The converter room is provided with an overhead travelling crane, and the whole of the floor is covered with cork carpet, which besides being a non-conductor of electricity and heat, adds an element of comfort which will, no doubt, be appreciated by that long-suffering individual, the sub-station attendant.

In conclusion, our thanks are due to Mr. A. D. Stevenson, of Messrs. Talbot & Stevenson, consulting engineers to the Borough Council, for facilities to visit and photograph the station, and to the contractors for details regarding the new type of converter, which has so quickly attained popularity.

Power Gas Installations.—THE POWER GAS CORPORATION, LTD., London, have just secured the contract for one of their special power gas installations of 1,000-B.H.P. capacity from the Arizona Copper Co., Ltd., and a plant of 750-I.H.P. capacity for the Nostell Colliery, Wakefield. In each case the plant is being installed for supplying gas to gas engines.

NOTES.

(*Continued from page* 760.)

The Tantalum Lamp in the United States.—It is announced that the Siemens & Halske Co., of Berlin, have made arrangements with the two largest makers of incandescent electric lamps in the United States for the working on royalty of the American patents for the Siemens tantalum lamp. The two companies concerned are the General Electric Co., of New York, and the National Electric Lamp Co., of Cleveland. The agreement entered into to this effect is of special interest, as it places the Siemens & Halske Co. in business relations with the American friends of the Berlin Allgemeine Elektricitäts Gesellschaft, although the understanding between the latter and certain firms in the United States does not prevent the American General Electric Co. from acquiring any German rights for working in the domains of the union.

Electric Supply Cricket League. — Mr. A. W. Seabright, the hon. secretary, *pro tem.*, asks us to state that a general meeting of this League will take place at the offices of the St. James' and Pall Mall Electric Light Co., 19, Carnaby Street, Golden Square, S.W., on Tuesday, May 22nd, at 7.30 p.m. Any clubs interested are requested to send a representative to the meeting. Mr. Seabright will be pleased to furnish them with any information.

Modern Power Stations.—Why, says one of our correspondents, should modern electric power stations be so painfully ugly? This is evidently a matter that has appealed to the Commissioners of Works, and is referred to in their Memorandum on the electric power and supply Bills. Stations particularly singled out are near Regent's and Greenwich Parks. The latter, no doubt, is the L.C.C. tramways station, where an unequal octagon has been used for the cross-section of the chimneys, and what might have passed for a coping has been crowned with a buttressed cylinder of brick, with a top of thin, irregularly projecting flat thin plates of iron. Some modern architects seem to think they are displaying the true commercial instinct when they build a power station with not a redeeming architectural feature in its outside or public view. In its Greenwich power station, the London County Council shows to the world just how little it really does care for the beauty of London, to conserve which it shouts so much, or for public opinion, which detests these needlessly ugly buildings.

Internationalisation of the Ganz Electrical Works.—The shareholders in the Buda-Pesth firm of Ganz & Co. have just sanctioned a scheme whereby the electrical department will become international in its character and of greater importance than was mentioned in this journal a few weeks ago. It appears that an arrangement has been entered into between the A.E.G.-Union Electricity Co., of Vienna, and Ganz & Co., for the formation of an independent company with a capital of 8,000,000 kronen to take over the electrical department of the Buda-Pesth Co., the purchase price being 3,500,000 kronen. The total share capital will be allotted in the proportion of 45 per cent. to Ganz & Co., 10 per cent. to the Credit Bank, and the remainder to the Berlin Allgemeine Co., the Vienna Union Electricity Co., and the General Electric Co., of New York. A second new company is to be constituted by the Hungarian General Credit Bank and Ganz & Co., to take over certain plant, patents and concessions, held by the latter, and to transfer them to the first new company at a low price, although the precise object of this particular arrangement is not obvious. When once formed the first company will enter upon a community of interests with the A.E.G.-Union Co., which will assure a mutual use of patents and inventions, and the profits in excess of 4 per cent. will be divided between the two parties in proportion to the share capital. It is further provided by the agreement that until December 31st, 1924, Ganz & Co., will not manufacture electrical goods or participate in any works which may do so. It is probable that the branches of the Ganz Co. in Ratibor and Lobersdorf, will also be transformed into independent companies.

Popular Engineering.—The gods forbid that those who wish for the abolition of mural advertisements shall have their way. Then would an invaluable source of amusement be taken from all of us who have eyes to see. The posters which advertise melodrama are the most delicious, and the heroine who, carrying her child, escapes from a burning house by walking across the street on a stack of telephone wires stretched conveniently from roof to roof; the unique design of locomotive and stationary engines; the peculiar construction of permanent way, and the astoundingly novel appearance of certain planing and sawing machines, which are just about to work the wicked will of the villain, will live always in our memories. It is to be assumed that the people who keep melodrama alive see nothing peculiar about these pictorial foretastes of the joy to be experienced for 4d., for there has been no improvement in the direction of accuracy within the last decade.

Possibly the same public who patronise melodrama maintain such periodicals as *Answers;* probably they gather all their engineering knowledge from it, and if the text is of a piece with the poster which has been covering our hoardings lately, it is not difficult to understand why glaring mechanical absurdities still persist in theatrical advertisements. This picture represents an appalling catastrophe in some kind of mill, which does not come within the Act. A huge pulley or fly-wheel, weighing 20 tons at the least computation, has broken loose, and amid a magnificent confusion of flying *débris* the workpeople run for dear life.

This immense wheel appears to be supported on a long shaft, some 1½ in. in diameter, which runs in blocks of wood forming brackets attached to the building. So far as can be seen, there is no particular reason for the wheel to be there, and our supposition is that it felt as if a little useful work would be a change, and decided to move; but why it has done this at an angle of 45° we are incompetent to explain, as we are not aware of any natural law which would permit it.

The whole thing is delightfully grotesque, and has been drawn by someone whose engineering attainments are insignificant; but while we can smile at it, and at things like it, we ought to remember that there is a considerable section of the community which regards these productions as infallible even if not as the highest form of art, and those people have just as much right and just as much need to be informed correctly as any other section.

Mural advertisements have played in the past, and will play to a greater degree in the future, a part in the education of the masses, but the character of that education must depend on the quality of the advertisements. Bad education is just as easily acquired as good, and we ought to look to it that no unnecesary stumbling block is put in the way of the latter.

The Electrobus.—It has been announced that the directors of the London Electrobus Co. have decided to return the subscriptions to all subscribers who desire it. Thus the trap has been re-opened, and if there are any subscribers who read the papers and exercise a moderate amount of intelligence, who still wish to remain within its jaws, their fate and that of their money will excite no compassion. We doubt, however, whether any so foolish will be found. Would that all schemes of the same unsound character could be disposed of in the same way.

According to the *Financial Times*, the "Oppermann" batteries which are—or were—to be used by the Electrobus are the invention of Mr. E. L. Oppermann, brother of Mr. Carl Oppermann, and the patents are the property of the X Electric Accumulator Co., Ltd., of 19A, Carlyle Square, Chelsea. In the construction of the plates the paste is mixed with finely sub-divided hair, which is destroyed by electrolytic action, leaving the plate in a highly porous condition. The battery consists of 44 cells, each weighing about 80 lb., and having a capacity of 550 ampere-hours, capable of running the 'bus for 30 miles. The British patent is No. 25,902 of 1904.

Birmingham Electrical Engineer Volunteers.—The annual dinner of the Birmingham detachment of the Electrical Engineers (Royal Engineer Volunteers) took place at the Central Restaurant, Corporation Street, last Saturday evening, Lieutenant J. F. Lister, who commands the detachment, presiding. In reply to the toast of "The Officers," proposed by Corporal Dickinson, Major Leaf, who commands C Company in London, of which the Birmingham detachment forms a part, congratulated Lieutenant Lister upon the excellent work his men had done during the past year. Major Leaf stated that at the Agricultural Hall they were going to have an opportunity of showing the public what the Volunteer Electrical Engineers could do.

Liverpool Electric Railway Fatality.—On Tuesday a man unknown, about 24 years of age, was found dead against a live rail on the Liverpool-Southport Electric Railway (L. and Y.), near Freshfield station. The dead man was of the working class, and was fairly well clad. His left arm was badly burned, and almost amputated at the shoulder. This makes the third fatality at Freshfield station within six weeks, for notwithstanding the fact that the company erected a footbridge here some time ago passengers persist in using the level crossing, hence the accidents that occur. At other points on the line where there are no level crossings there is practically entire immunity from accident on the electric railway.

A London Traffic Board.—A Bill has been introduced by Sir John Dickson-Poynder to establish a London Traffic Board in accordance with the recommendations of the Royal Commission. It is proposed that the Board shall be an advisory body, no legislative or executive powers being conferred upon it.

Institution Notes.—Royal Society.—The *Times* says that the following 15 candidates were on 3rd inst. elected into the Royal Society:—Charles William Andrews, George Thomas Beilby, Frederick Frost Blackman, Thomas John I'Anson Bromwich, Philip Herbert Cowell, Walter Heape, James Hopwood Jeans, Charles Herbert Lees, Captain Henry George Lyons, R.E., Archibald B. Macallum, James Ernest Marsh, Peter Chalmers Mitchell, James Swinburne, Harold A. Wilson, and Almroth Edward Wright.

Royal Institution.—Last Friday the Hon. Charles A. Parsons delivered a lecture on "Steam Turbines." He said that six years ago there were 65,000 H.P. of turbines on land and 25,000 on sea; now, however, there were more than 2 millions of horse-power at work on land and 800,000 at work on, or being built for, the sea. There appeared to be no probability at present of a successful gas turbine or turbine locomotive being invented. A turbine motor-car, however, seemed to be within the field of practical mechanics.

At a meeting held on Monday, Mr. W. M. Mordey was elected a member. The following vice-presidents were nominated for the ensuing year:—Lord Alverstone, Sir William Huggins, Lord Kelvin, Dr. Ludwig Mond, Lord Sanderson, Sir James Stirling, Sir James Crichton-Browne (treasurer), and Sir William Crookes (honorary secretary).

I.E.E. (Students).—The visit that was arranged to take place on the 19th inst. to the L.C.C. generating station at Greenwich, has been postponed.

Appointments Vacant.—Chief assistant electrical engineer for the Hoylake and West Kirby U.D.C. (£125); fitter for the Lagos Government Electric Light Department (£240).

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station Engineers.—The Dudley T.C. has re-appointed Mr. R. P. WILSON, chief engineer at the Corporation electrical works at a salary of £325 per annum, and 2½ per cent. on capital outlay, Mr. Wilson to find two competent assistants. It was stated at the Council meeting that during the last six years Mr. Wilson had received in commission £5,040, in addition to salary to the amount of £2,000.

The Blackburn T.C. has increased the salary of the electrical engineer, Mr. P. P. WHEELWRIGHT, from £300 to £350 per annum, with annual increments of £25 to a maximum of £500.

At the meeting of St. Helens T.C. on May 2nd, it was stated that the proposed increase of the salary of Mr. HOLLINGSWORTH, electrical engineer, from £400 to £450 per annum had been withdrawn.

Mr. J. H. FOOKS-BALE, electrical engineer and tramways manager to the Walthamstow Urban District Council, who has received the appointment of manager of the motor department of the London General Omnibus Co., was on May 2nd, 1906, at the Essex Brewery Tap Hotel, made the recipient of an illuminated address as a parting gift from the employés. Councillor Lord occupied the chair. Amongst those present were Mr. Murray (the new tramways manager), and many of the officials and men of the tramways and electrical departments. Songs and music were contributed during the evening by various employés. Councillor Anderson made the presentation, which consisted of an illuminated address, and a gold bracelet for Mrs. Bale.

The shift engineers of Fulham, MESSRS. WELCH, ELLIS and ZOLLER, are to have their salaries increased from £2 2s. 6d. to £2 7s. 6d. per week. The Borough Council on inquiry found that the average salary paid to such officials in London is £130 per annum, some receiving as much as £160 to £190. Mr. Fuller, electrical engineer, strongly supported the increase, pointing out that the Fulham station is one of the most difficult in the metropolitan area to work.

Mr. R. F. JEWELL, shift engineer at Southwark, has resigned his position, he having been appointed chief engineer to the Gosport and Alverstoke Electricity Supply Co.

Tramway Officials.—Mr. F. MELLOR, of the Oldham tramway staff, on leaving to become depôt foreman of the Swindon tramways, has been presented by the employés at Oldham with a writing desk.

General.—The *Railway Gazette* says that recently at the Midland Railway Institute, Derby, Mr. GUSTAV BEHRENS, one of the Midland Railway directors, unveiled a large portrait of the late Mr. W. E. LANGDON, who was for 25 years, 1878-1903, the telegraph superintendent of the Midland Railway. Mr. SAYERS, Mr. Langdon's successor in the position, in opening the proceedings, stated that the portrait was the outcome of a desire on the part of the chief officers of the department who had been associated with Mr. Langdon during the greater term of his office, to have a permanent memorial of their old chief.

The Hackney B.C. has appointed Mr. BROOK DYSON to be electrical draughtsman, at £130 per annum.

Mr. S. J. EBBUTT, manager of the Telephone, Telegraph, and Signalling Department, Birmingham branch (and previously Newcastle-on-Tyne) of the General Electric Co., Ltd., has resigned his position, and is at present directing his movements from 79, Eastwood Road, Birmingham.

Messrs. Goodwin & Co. inform us that their Australian representative, Mr. C. O. WHITE, is now on a visit to Birmingham, and is interesting himself in any new lines in electrical machinery or fittings likely to suit their friends abroad. Manufacturers who have special patterns to show are requested to call upon him at Messrs. Goodwin & Co.'s offices, Fleet Street, Birmingham.

From *Indian Engineering* we learn that Mr. J. W. MEARES, electrical adviser to the Government of India, will shortly proceed home on leave. Mr. R. J. BROWNE, the electrical engineer, Military Works Services, will act as electrical adviser to the Government during Mr. Meares's absence.

Mr. H. POMEROY, superintending engineer, Midland District, who has retired from the Post Office after 48 years' service, was entertained to dinner at the Dolphin Hotel, Dublin, on Saturday, April 28th, by his brother officers. Mr. J. Sheridan, acting superintending engineer, the senior engineering officer present, occupied the chair, and was supported by Mr. Harkness, surveyor of the Southern District; Mr. Shannon, of the Secretary's Office; Mr. Thompson, assistant surveyor of the Midland District, &c. The toast of "The King" having been honoured, Mr. Kinsey read the address to Mr. Pomeroy, who was asked to accept a solid silver casket as a memento of the kindly feelings of his engineering and other colleagues. The remainder of the evening was spent in song.

Mr. JOHN HESKETH, having been transferred from the position of Electrical Engineer for the State of Queensland to that of Chief Electrical Engineer on the Postmaster-General's Central Staff, his address will in future be—Postmaster-General's Department, Spring Street, Melbourne, Vic.

Mr. H. L. TURNER, who has been engaged for several years in the erection of the Turner patent automatic point controller for Messrs. S. Dixon & Son, Ltd., of Leeds, has now joined the staff at the firm's London office, 22, Walbrook, E.C.

Mr. J. BRYDEN BROWN, who at present is holding the position of district engineer to the Electric Supply Corporation at Exmouth, Totnes and Falmouth, has been appointed sub-manager in the suction gas department of Messrs. Kynochs, Ltd., of Birmingham.

Obituary.—MR. W. S. ANDREWS.—We regret to announce the death of another of the old pioneers of electric telegraphy—Mr. W. S. Andrews, who was intimately connected with the management of the Indo-European Telegraph Co. for many years up to the end of 1904, and was also widely known in connection with various other cable and telegraphic enterprises. Mr. Andrews passed away on 4th inst. at his residence at Sevenoaks at the age of 74 years. During his lengthy career Mr. Andrews was intimately associated with the development of submarine telegraphy, his connection with this branch of industry having begun as early as 1848 under Mr. C. V. Walker, then electrical engineer to the South-Eastern Railway Telegraphs. Mr. Andrews was responsible for many inventions, some of which have been patented and have met with considerable success. It was due to the strain of literary work proving too great that he turned his attention to telegraphy, and in the early fifties he accepted the post of acting engineer to the Submarine Telegraph Co. This position he retained for eight years, gaining varied experience of submarine cable work. He took charge of the repairing ship for the Danish Government, and was engaged on other work of a similar character. During this period he was London secretary to the British and Irish Magnetic Telegraph Co., and gave assistance in extending telegraphic communication with the Continent, and particularly in simplifying tariff charges. In these early days the use of the telegraph was mainly in reporting shipping items and Parliamentary speeches. The British and Irish Co. supplied reporters for this work, and acted somewhat on the lines of the news agencies now working. In the fifties both the cables belonging to the Submarine Cable Co. were broken, and these repairs were effected by Mr. Andrews from luggers, this being considered at the time a considerable feat. Mr. Andrews joined the United Kingdom Telegraph Co. in 1860 as manager and secretary, later on taking up the duties of electrician and engineer. This company was at the time in low water, but ultimately became thoroughly sound financially, and it was at this period that the Government took over the telegraphs. When the British Electric Telegraph Co. went into liquidation on its amalgamation with the British and Irish Telegraph Co., Mr. Andrews was appointed official liquidator, and occupied that position for three years. At the date of the transfer in 1870 the ownership of the telegraphs was in the hands of three companies, the Electric Telegraph Co., the British and Irish Co. and the United Kingdom Co., plus one or two smaller and less important undertakings, and the terms which were discussed by the Post Office representatives were formulated by Mr. Andrews, were accepted, and were finally embodied in the Bill without material alteration, and speedily became law. It was while Mr. Andrews was associated with the above-mentioned companies that the system of allocating special telegraph lines for the leading provincial newspapers was introduced, the first country paper to adopt this advantage being the *Scotsman*. There are now few of the leading journals who have not this indispensable adjunct. In 1870, after the transfer of the home telegraphs to the Government, Mr. Andrews joined the Indo-European Telegraph Co. as manager and secretary, and later (in 1884), in recognition of his services, was appointed managing director, with a seat on the board. In the early days the Indo Co. found a difficulty in earning sufficient revenue to cover necessary expenses, and it was Mr. Andrews' work to bring about a reduction of the various outpayments made to the Government in connection with landlines in this country, &c. These and other negotiations with the object of reducing the standing charges proved successful, and the Indo Co. became a thoroughly sound and regular dividend-earning undertaking. In the subject of the protection of submarine telegraph cables from careless and wanton damage Mr. Andrews has taken a lively interest, and as a representative of the Indo-European and other companies at the International Telegraph Conferences he has, in association with other distinguished representatives of British submarine telegraph cable enterprise, shared in successfully protecting the interests of the companies. After 30 years of active service, Mr. Andrews retired at the end of 1899 from the post of managing director of the Indo-European Co., his latest work in that position being the procuration of an extension of the company's Russian and Persian concessions for a further period of 20 years. In 1877 he was elected a director of the Western and Brazilian Telegraph Co., and in 1888 he became chairman of the company. In 1898 the amalgamation of the Western and Brazilian Co. and the Brazilian Submarine Co. took place, and Mr. Andrews became chairman of the combined undertaking registered as the Western Telegraph Co., a position he retained until his resignation in 1902. Mr. Andrews joined the West India and Panama Co. in 1874, and became its chairman on the death of Mr. Earle in 1897. In 1895 the Amazon Telegraph Co. was established, and Mr. Andrews was elected chairman. Mr. Andrews has received recognition from the Persian Government in connection with his management of the

Indo-European Co.'s service, the Shah having conferred upon him the distinction of a Grand Officer of the Second Class of the Lion and the Sun.

NEW COMPANIES REGISTERED.

Thames Iron Syndicate, Ltd. (88,626).—This company was registered on May 3rd, with a capital of £4,500 in £1 shares, to acquire from Sherard Cowper-Coles, of 82, Victoria Street, Westminster, interests in certain existing inventions relating to the manufacture of iron cylinders, tubes and similar articles, and to the electro-deposition of iron, and to carry on the business of iron-masters, iron merchants, steel makers and converters, founders, electricians, engineers, suppliers of electricity, &c. The first subscribers are:—A. M. Alexander, M.I.C.E., Magdala House, Buckhurst Hill, 10 shares; G. C. Mackrow, Tay Villa, Romford Road, Forest Gate, naval architect, 10 shares; D. Urquhart, 427A, Strand, W.C., electrical engineer, 10 shares; H. P. Hussey, 8, Culford Mansions, S.W., secretary, 1 share; G. M. Drummond, 25, Cleveland Road, South Woodford, clerk, 1 share; L. M. Bowen, 23, Burgess Road, East Ham, clerk, 1 share; and W. W. Giles, 34, Manor Road, Stoke Newington, N., clerk, 1 share. No initial public issue; the number of directors is not to be less than three or more than five; the first are A. M. Alexander, M.I.C.E., G. C. Mackrow, D. Urquhart, and A. F. Hills; qualification, £10; remuneration as fixed by the company. Registered office, Thames Ironworks, Victoria Dock Road, Canning Town, E.

Scottish Electrobus Co., Ltd. (88,617).—This company was registered on May 2nd, with a capital of £100 in £1 shares, to adopt an agreement with the X Electric Accumulator Co., Ltd., and to carry on the business of motor-car, omnibus, van and cab proprietors, jobmasters, contractors, &c. The first subscribers (each with one share) are:—G. H. Lloyd, 20, Half Moon Street, W., mechanical engineer; E. L. Oppermann, 21, Ashworth Mansions, Elgin Avenue, W., electrical engineer; H. C. Lloyd, 108, New Bond Street, W., gentleman; G. W. Statham, 21, Ironmonger Lane, E.C., solicitor; J. McCanna, 9, Upper Chadwell Street, E.C., managing clerk; C. N. Jolly, 44, Stockwell Park Crescent, S.W., clerk; and W. H. Armstrong, 4, Bedford Place, London. No initial public issue. Registered without articles of association.

Engineering, Electric and Construction Syndicate, Ltd. (88,633).—This company was registered on May 4th, with a capital of £100,000 in £1 shares, to construct, equip and control electrical power and light supply works, telephonic, telegraphic, gas, water and hydraulic power works, railways, tramways, docks, harbours, piers, wharves, factories, roads, drainage and sanitary works, and other public or private buildings, works or conveniences, and to carry on the business of mechanical and electrical engineers, founders, contractors, &c. The first subscribers (each with one share) are:—I. B. Keith, 13, Eliot Place, Blackheath, gentleman; C. K. Cartwright, Netherton, Cambridge Road, Bromley, Kent, clerk; J. P. Moore, 50, Rostrevor Road, S.W., clerk; T. C. Wilkins, 1, Oakley Villas, Chelmsford Road, South Woodford, clerk; A. E. H. Sutton, 79, Carysfort Road, Stoke Newington, N., clerk; J. A. MacLean, 40, Norton Folgate, E., clerk; and W. Sinclair, 51, Streathbourne Road, S.W., accountant. No initial public issue. The number of directors is not to be less than three or more than seven; the first are C. G. Arbuthnot, H. L. Arbuthnot, H. R. Arbuthnot, L. G. Arbuthnot, and W. R. Arbuthnot; qualification, £500; remuneration as fixed by the company.

Anglo-Nigerian Co., Ltd. (88,585).—This company was registered on May 1st, with a capital of £1,000 in £1 shares, to carry on the business of traders, shippers, brokers, concessionaires, bankers, promoters, engineers, electricians, suppliers of gas, water, and electricity for light, heat and power, &c. The first subscribers are:—W. F. Boyle, 2, Ridgmount Gardens, Gower Street, W.C., African merchant, 25 shares; T. H. Smith, 34, Redbourn Avenue, Finchley, N., gentleman, 25 shares; E. B. S. Aston, 19, Dalmeny Avenue, Camden Road, N., engineer, 25 shares; J. B. Mills, Lyndhurst, Sandyhill Road, Wallington, Surrey, clothing manufacturer, 10 shares; J. G. Mills, Lyndhurst, Sandyhill Road, Wallington, Surrey, manufacturer, 10 shares; C. H. Brown, 8, Princes Street, Westminster, S.W., surveyor, 5 shares; and C. O. Spencer, 8, Princes Street, Westminster, S.W., surveyor, 5 shares. No initial public issue. The number of directors is not to be less than two or more than five; the subscribers are to appoint the first; qualification, £25; remuneration as fixed by the company. Registered office, Boston House, New Bond Street, E.C.

Cox-Walkers, Ltd. (88,588).—This company was registered on May 1st, with a capital of £10,000 in £1 shares (ordinary or preference), to adopt an agreement with Edward Cox-Walker, O. Cox-Walker, Edgar Cox-Walker and T. M. Cox-Walker, for the acquisition of the businesses carried on at "Cox-Walkers" and "Cox-Walker and Sons," and to carry on the business of electrical, automobile and general engineers, manufacturers of and dealers in electrical engineering and other goods, apparatus and appliances, &c. The first subscribers (each with one share) are:—Edward Cox-Walker, Highfield, Consicliffe Road, Darlington, electrical engineer; Mrs. E. L. Cox-Walker, Highfield, Consicliffe Road, Darlington; Miss E. M. Cox-Walker, Highfield, Consicliffe Road, Darlington; O. Cox-Walker, 1, Upper Westbrook Road, Darlington, electrical engineer; Edgar Cox-Walker, Wood Leigh, Darlington, electrical engineer; T. M. Cox-Walker, Vane Terrace, Darlington, electrical engineer; and W. Heslop, jun., 8, Priestgate, Darlington, accountant. No initial public issue. The number of directors is not to be less than two or more than five; the first are Edward Cox-Walker (governing director), Edgar Cox-Walker and T. M. Cox-Walker; qualification of governing director 500 shares; of other directors 250 shares; remuneration as fixed by the company.

CITY NOTES.

The Berlin Underground Railway Co.

The report has been issued for 1905 of the Berlin Elevated and Underground Railway Co., which thus celebrates the ninth year of its existence as a company. The railway, which is partly high level and partly of the shallow underground type, now has a total length of nearly seven miles, and is to be extended a further length of four miles and a half in the course of the next few years. The principal items contained in the accounts are as follows:—

	1905.	1904.
Ordinary share capital	£1,500,000	£1,500,000
Revenue	224,987	208,190
Working expenses	118,985	113,471
Gross surplus	106,022	94,719
Renewal fund	17,500	15,000
Depreciation	9,273	4,094
Net profits	77,628	66,822
Dividend, per cent.	4½	4

In addition to the ordinary share capital the company has issued obligations to a considerable extent; the dividend paid in 1903 was 3½ per cent., and in 1902 4 per cent. The number of passengers carried in 1905 was 34,530,000 as compared with 32,120,000 in the preceding year, and the average receipts per passenger were 1·488d. as compared with 1·483d. in 1904. At the end of 1905 the company had 846 workmen in its employ, or 55 in excess of those engaged at the end of the previous year.

Great Northern Telegraph Co. of Copenhagen.

At the general meeting held at Copenhagen on April 28th, the chairman and managing director, Commodore E. Suenson, D.R.N., in rendering an account of the working of the company during the year 1905, stated that the company's cables had not suffered so much from interruptions in 1905 as in the previous year. In Europe there had been 15 interruptions on nine cables, and in the Far East 13 interruptions on five cables, not counting the two cables between Vladivostock and Nagasaki, which have remained closed the whole year. After the ratification of the Portsmouth peace in October, the company obtained permission to examine the condition of these cables and found both of them to be interrupted. Some of the breaks were repaired in December, but the year closed without the repair of some other breaks close to Vladivostock. The *Pacific* succeeded on January 14th this year in restoring one of the cables, and at the same time the Russian Government permitted the company to re-open its station at Vladivostock and to resume the direct service between Vladivostock and Nagasaki, which had been suspended since February 9th, 1904. The repair of the other cable had, however, to be postponed till the spring, the approaches to Vladivostock being ice-bound. In Europe the cable steamer *H. C. Orsted* was 123 days on active service, 13 of which were for the account of others, whilst in the Far East the *Store Nordiske* and *Pacific* were similarly occupied for 161 days, 62 of which were for the account of others.

Owing to the interruption of the Vladivostock cables, the Vladivostock and Kiachta route remained closed to all traffic between Europe and the Far East, but was, as in 1904, replaced by the Peking-Kiachta-Irkutsk route. This comparatively satisfactory state of affairs lasted till November, when the revolutionary movements in Russia, and the strike of the postal and telegraphic employés in Russia and Finland, paralysed not only the service *vid* Peking-Irkutsk and on the lines in Siberia, but also the working of the lines in European Russia, including the connections between the Libau and Nystad cable stations and the central station at St. Petersburg. The Danish staff at those places and elsewhere did not take any part whatever in the mutiny of their Russian colleagues; on the contrary, they stuck generally most conscientiously to their duty until the wires were cut by the revolutionists. The latter, however, left the company's staff unmolested, and respected their firmness and devotion to duty.

During the war and the peace negotiations the traffic receipts remained at about the same figure as in the corresponding period of 1904, or even higher, but they naturally decreased considerably after the conclusion of peace, and particularly during the revolutionary disturbances in Russia, which decrease was still manifest. The total receipts for the year had, nevertheless, not been affected, thanks to an increase in the proceeds from participation in other telegraph undertakings, and also to a considerable increase under the headings "Profit on Exchange" and "Sundries." The additional revenue had, however, been absorbed by an increase of expenditure. The financial result had been about the same as for the previous year. The board proposed to pay a dividend for 1905 of 12½ per cent. (including the 5 per cent. already paid), and the altogether exceptional bonus of 11½ per cent., or 24 per cent. in all, placing the same amounts as in 1904 to the reserve fund and the dividend equalisation fund.

The contract for the cable to Iceland has been given to the Telegraph Construction & Maintenance Co. The cable will consist of two sections, one connecting the Shetland Islands with Thorshavn, the principal place on the Faroe Islands, and the other will be laid from the latter point to Seydisfjord, a small town situated at the end of the fjord of the same name on the East Coast of Iceland. The total length of these two cables will be about 600 n.m., including spare cable, and they will probably be laid in August. The station buildings and the necessary cable houses at the various landing places are under erection. The telegraph and telephone lines connecting Reykjavik, the capital of Iceland, on the West Coast with Seydisfjord and intermediate towns, will be constructed by the Government of Iceland, and at their expense, the company contributing about £16,800 once for all. This line has to be completed and opened by October 1st next at the latest.

The company has obtained from the Swedish Government an extension of its concession similar to the one granted last year by the Danish Government.

A German cable was laid and opened in 1905 from Shanghai (Woosung), connecting China with the Island of Yap, and with extensions to Guam and the Dutch Indies. These cables belong to the German Dutch Telegraph Co. Quite lately, in March and

April of the current year, the American Commercial Pacific Cable Co. completed their system between America and Asia by the laying of a cable between Manila and Shanghai, and of another cable between Guam and the Bonin Islands, which have at the same time been connected with the mainland of Japan by a cable belonging to the Japanese Government. The mouth of the Yangtze River and its narrow tributary, the Whangpoo, have now been crowded with submarine telegraph cables to such an extent that it will be extremely difficult to increase their number, and still more difficult to repair those cables when breaks or faults occur. The owners of the numerous cables landing in China have made arrangements with the company for the general repairing and maintenance of their cables.

Urban Electric Supply Co.

Mr. F. E. Gripper presided at the Westminster Palace Hotel on Thursday last week over the annual meeting of the above company.

In moving the adoption of the report (see Electrical Review, May 4th), the Chairman said that last year was really the first that the whole of their stations had actually been in operation. The last of their stations, which they constructed at Newbury, was opened at the beginning of the year; and the policy of the board was not to deal with any further stations, but to devote the resources of the company to the thorough development of the stations which they were working at the present time. The past year had been rather an anxious time for most electric lighting companies throughout the country. The competition which electric light had had to work against in connection with improved gas lighting had been very severe, and in many cases the result had been that electric lighting companies had had to take reduced prices for their supply. At the same time, consumers had been inclined to economise. They had learned the most economical way of using the light, and had also the advantage of more efficient lamps. The Nernst lamps and high efficiency ordinary incandescent lamps gave them the same amount of light for a less amount of current consumed, so that in most cases there had been a falling off in the current consumed for each lamp. Of course, these conditions could only be counterbalanced by obtaining an increase in the number of consumers and in the number of lamps added to their mains, and also by an increased economy in the production of the current. The results of the past year's working showed a substantial progress in both these directions. The new lamps which they had connected during the year were just over 80,000, which was a very large increase, the figures being raised from 215,000 lamps to 295,000. Their profits had increased from £21,000 to £27,900. The accounts had been presented in the same form as last year, and the detailed accounts of the working of each of the 13 stations could be furnished to any shareholder who might like to inspect them. All the accounts of each undertaking were kept separate, and were audited by the Board of Trade. Turning to the balance-sheet, they would see that the net profit, after deducting the head office expenses, including directors', auditors' and trustees' fees, amounted to £26,297 12s. 10d. The debenture and loan interest absorbed £9,185 16s. 5d., leaving a balance to be dealt with of £17,111 16s. 5d., which was available for paying dividends on the preference and ordinary shares. The amount required to pay the 5 per cent. guaranteed dividend on both preference and ordinary shares was £24,702 14s. 10d., and the necessary balance of £7,590 had been paid by Edmundson's Electricity Corporation under the terms of their contract. The capital expenditure, which was shown in detail in the balance-sheet, amounted to £970,240, being an increase of £148,000 over last year. This expenditure in the past years had been partly for completing one or two of the stations, while about £44,000 had been expended in adding additional plant and machinery to the existing works. The remaining sum had been required for largely extending the system of mains and in making connections for the new consumers. They had had very large extensions in connection with their Thames Valley undertaking in the Twickenham, Hampton and Walton district. They had now practically completed their system of supply mains, and their capital expenditure in future years would be very small compared with that of the past. All their stations were equipped for meeting a largely extended demand for consumers. One item which had not appeared before probably required some explanation, which was the charge of £1,666 on account of electrical exhibitions. During the year they organised a series of exhibitions in the various towns in which they were interested, to show the way electricity could be utilised for various purposes. The result of those exhibitions, although they did not appear immediately, would be lasting, and on that account the cost had been spread over three years, one-third being wiped out that year. During the year 20,000 preference shares and 30,000 ordinary shares had been issued and fully paid up, and that practically completed the amount of capital they were authorised to issue. Last year mention was made of their having to go to Parliament to get certain powers to overcome legal difficulties which had cropped up in connection with their supply to Walton from their generating station at Weybridge, and they were successful in their application, notwithstanding the opposition of the Weybridge local authority. In the present session they were making a somewhat similar application with regard to Twickenham, and the Bill was being unopposed, so that they would not be put to any considerable expense.

Mr. Page seconded the motion.

Replying to a Shareholder, the Chairman said that, under the contract with Edmundson's Corporation it was provided that depreciation should commence at the end of that year. The guarantee extended to 1910, and it was provided that depreciation at the rate of 1 per cent. on the total amount of capital on works which had been in existence five years should be set aside. The question of preliminary expenses and discount on debenture stock was a matter which could not be dealt with until the guarantee time had expired, or otherwise it would mean that Edmundson's would have to be called in to define that.

A Shareholder pointed out that in the prospectus it was stated that £300,000 would be expended in the first year, and that in 1907 the capital expenditure would probably be £650,000, whereas the company had expended £970,000. The revenue was estimated to be £42,000 in 1907 on a capital expenditure of £65,000. The company had spent £970,000, and had a return of £28,000. He complained that there had been reckless expenditure of money on small towns.

The Chairman admitted that the figures mentioned were those of Mr. Medhurst, who was then the engineer, and he did not know that Mr. Medhurst was to blame, seeing that the estimate was made five years ago. He estimated that the actual cost would be 2½d. a unit, and the selling price 5½d. per unit, which was a common price at the time. As a matter of fact, they had made something under 2d. a unit profit. Mr. Medhurst estimated that in 1907 they would be selling 2,800,000 units, but in the past year they had sold 3,500,000 units. They had spent money in extending existing undertakings, and he thought they had been rightly advised in so doing. They had spent more than was anticipated at first, because they had adopted a policy of giving facilities for intending customers to get a supply instead of waiting until they were forced to afford those facilities. He could not, of course, say what their revenue would be, but it was increasing regularly from year to year, and he believed that in a few years their revenue would justify the expenditure which had taken place.

Raworth's Traction Patents, Ltd.

At the meeting of this company, held on 1st inst., the Chairman said that the result of the first year's working was entirely satisfactory. It was certainly not usual for a limited company exploiting a patent to pay a dividend after the first year's working, but the company was capitalised on a moderate basis, and as the vendor's interest was made dependent on the success of the company, almost the entire cash resources of the company had been available for the purposes of the business. After reviewing the accounts the Chairman said that as regards the company's inventions, it had been known for many years that the shunt-wound motor was a desirable traction motor, but prior to the advent of this invention no successful application of the shunt motor for traction purposes had been made. The series motor achieved no success until the present series-parallel controller could be entrusted to be used by an ordinary car driver. The shunt motor up to the present time was in the same position and waited for the controller. The regenerative controller, as now made by this company for the shunt motor, was, to all appearance, like the series-parallel controller, and they believed that it would prove equally efficient and trustworthy. When they commenced business the company held patents covering the principle of the new system, and they had a controller which gave good results, but it did not satisfy every one; in the first place, it was not like the ordinary controller; secondly, it did not do all the ordinary controller did; and, thirdly, it did not put the motors in parallel. He thought it was a matter of congratulation that these results had been achieved in so short a time, and at so small an expenditure. It was largely due to the satisfactory arrangements made with Mr. Raworth, who became managing director at a comparatively small salary, and to their having acquired the services of his two sons, as assistant engineers. It was very largely due to this combination of experience and youthful energy, that the development of the company's patents had been so successful. The directors considered the outlook promising. They had no doubt many difficulties before them, as was always the case when introducing on to the market anything new which came into competition with old-established practice and conditions, but acknowledging that there were difficulties was halfway to overcoming them, and it was the intention of the board, step by step, to fight their way through these difficulties, which could and would be overcome.

Kalgoorlie Electric Tramways.

The second ordinary general meeting of the above company was held on Wednesday at the Chamber of Commerce, Salter's Hall Court, under the chairmanship of Mr. A. H. P. Stoneham.

In moving the adoption of the report, the Chairman said the figures spoke for themselves, and he thought the shareholders would agree that the results recorded were very satisfactory, and to many of them they would be very astonishing. The town of Kalgoorlie was still a new town, and he found a good many people were under the impression that it was still a mushroom mining camp. To those people it would come as a surprise to learn that upwards of 3,300,000 people were carried during the past year, and that the cars travelled 683,827 miles, which was more than 13,000 miles per week, and

nearly 2,000 miles per day. It would also come as a surprise to many people to know that the receipts averaged upwards of £1,000 per week, the total for the year being £53,512. Last year he explained that although the traffics were very satisfactory, the price they were paying for power was so exorbitant that he feared there would be nothing for them to do but to build their own power house, although, perhaps, it was foolish to do so with such a fine installation at hand as that provided by the Kalgoorlie Power Co. They had always worked in the most friendly arrangement with the Kalgoorlie Power Co., and the question of price was the only difference between them. Perhaps they would wonder why they made such a contract at such a high price in the first instance, and the answer was that if they had erected their own power house, it would have been 18 months or 2 years before they could have commenced working. They, therefore, made arrangements with the Power Co. on the understanding that as the first and largest customer, they should always receive the most favoured nation treatment. Well, events moved very quickly in Australia, and at the time the agreement was come to, it was thought that Sir J. Forrest's gigantic scheme to pump fresh water from Perth to Kalgoorlie would be a failure. As it was it had proved a gigantic success, and Kalgoorlie was now supplied with fresh water through a pipe line from Perth, a distance of 390 miles. The result of this water supply from Perth was that the Power Co. were able to produce power at a much cheaper rate than they were formerly able to do, and their company consequently claimed a corresponding reduction in the price they paid for power. Needless to say, the directors of the Power Co. wished to do their best for their own shareholders, and the result was long and complicated negotiations. He was glad to say these negotiations had resulted in the price for power being reduced from 4d. to 2¾d. per unit, and he believed this would be a satisfactory arrangement for both companies. He would take that opportunity of paying a tribute to the efficient way in which the Power Co. was managed, for they had never had a breakdown on their system owing to a defective supply of power. The negotiations he had referred to necessitated the drawing up of all sorts of legal documents on behalf not only of the company, but of the debenture-holders, whose consent had to be obtained, and this accounted for the large item which appeared under the head of law costs. The profit for the year was just under £16,000, and by the saving of £4,000 a year on the cost of current they anticipated a profit of £20,000 at the end of the current year. The whole of the cost of the negotiations had been charged to this year's account, although they might fairly have been charged over a period. The interest and sinking fund on the "A" and "B" debenture stock amounted to £15,000 per annum, and this would redeem the "A" stock in 17 years and the "B" stock in 9 years, so that they could reckon on £5,000 surplus over and above the interest and sinking fund. They might want to know whether that profit could be relied upon after making proper allowance for repairs and maintenance, and he could assure them that every attention was paid to that, and such expenses were charged against profit and loss. It had been suggested that the poles and sleepers might be eaten by the white ants, and would require renewing, but at Perth they had lately taken up sleepers and examined poles which had been in use for 13 years, and they were in an absolutely perfect state, which showed the wisdom of using Australian Jarrah wood. As to the permanency of Kalgoorlie, he believed in it, and the construction of permanent buildings, and the laying out of parks showed that the Australian people were convinced that it was going to last. Some people also thought that the motor-'bus was going to sound the death knell of tramways. Well, he was frequently in France, and although the French people were willing to make motor-'buses and sell them to English companies, they did not see them on the streets of Paris. He had come to the conclusion that the French people knew better than to risk their money in that way. They did not believe in running them themselves, and neither did he.

Mr. C. C. Baker seconded the motion.

Mr. Beale, an Australian trader on a visit to England, spoke in eulogistic terms of the company's service in Kalgoorlie, and said there were finer tramways there than in Chicago and New York.

The report was then adopted.

Madras Electric Supply Corporation.

The statutory meeting of this company was held on Wednesday, at Salisbury House, London Wall, Mr. A. M. H. Walrond in the chair.

The Chairman said that it would be remembered that the company was registered on January 27th, 1906. The draft of the prospectus was submitted to the Madras Government and approved by them, who also sanctioned the transfer of the statutory powers or licence and the creation of the mortgage charge. The prospectus was issued to the public on February 12th, inviting subscriptions for £300,000—£250,000 in construction debenture stock and £50,000 in shares. The issue was apparently popular, for within an hour of the issue the debenture stock was over-subscribed, and the directors had some considerable trouble in settling the allotments. They went to allotment on February 17th, and 50 per cent. had since been paid up. He thought they would consider it very satisfactory that the cost of raising this £300,000 was only a little over 2 per cent., which compared very favourably with most other issues. There was naturally very little information which could be given to the shareholders as yet. They had secured, on what the board considered very favourable terms, a site for the generating station, which was large enough for any future extensions, and was situated in a favourable position adjoining the railway and canal. They had appointed Mr. E. C. St. John as chief engineer of the company. He sailed from England on April 22nd, so he would shortly be on the spot to look after their interests. They had every reason to be satisfied with the appointment, Mr. St. John coming to them with the highest recommendations. Through the courtesy of the board of the Calcutta Electric Supply Corporation, Mr. St. John was going in the first instance to spend some time in Calcutta to see exactly what they had done and were doing. They would readily understand the great advantage this would be to them, and he would like to take that opportunity of thanking the board of the Calcutta company for granting them that privilege. They would also be glad to hear that they were receiving a great many applications already for power and light; in fact, it was under the serious consideration of the directors if it might not be worth while to erect temporary buildings to enable them to be in a position to supply current as early as possible. Under their contract with Messrs. Crompton & Co., Ltd., they expected to be able to commence supplying current in the autumn of next year, and the whole contract should be completed by the spring of 1908.

Western Telegraph Co.

The report of the directors for the half-year ended December 31st, 1905, states that the revenue for this period amounted to £296,665, and the working expenses to £128,006. After providing £14,163 for debenture stock and debenture interest and sinking fund, and £4,979 for income-tax, there remains a balance of £149,517, to which is added the sum of £3,132 brought forward from June 30th last, making a total of £152,648. First and second interim dividends, amounting to £62,379, have been paid, and after transferring £80,000 to the general reserve fund, and £5,000 to the Maintenance Ships' Reserve Fund, there remains a balance of £5,269, which is carried forward to the next account.

Dudley, Stourbridge and District Electric Traction Co.

The directors' report that the gross receipts for the year 1905 were £46,662 and the expenditure £34,330, including £500 placed to depreciation and renewals account, interest on debentures, cost of repairs and maintenance, and all other expenses properly chargeable against revenue, leaving a balance of £12,332. The directors recommend that there be placed to reserve (sinking) fund £2,100, to the payment of a dividend at the rate of £5 per cent. per annum on the ordinary shares £5,000, and that £500 be carried forward. The expenditure on capital account during the year has amounted to £8,619, and a further issue of £25,000 debenture stock has been made, making the total now issued £85,000. The working under one management of the company's tramways and light railways with those of other companies owning and working tramways and omnibuses in the district has, as the directors anticipated, resulted in considerable economies being effected in costs of operation during the past year. A satisfactory increase in revenue through the interchange of traffic rendered possible by the arrangement has also taken place. The prolonged negotiations with the Dudley Corporation in regard to the postponement of purchase of the lines having been brought to a close by the appointment of an arbitrator under the agreement with the Corporation, an inquiry was held in February and March last, with the result that the arbitrator has fixed £32,957 as the price to be paid by the Corporation for the tramways of the company. As to Light Railway No. 5, the sum of £32,576 has been fixed, if the Court decide that it shall be purchased under the terms of the Light Railway Act, 1896. If, however, it is decided that it shall be purchased as a tramway, the price to be paid by the Corporation has been fixed at £16,548. As to Light Railways 6 and 6*a*, the price has been agreed at £2,200. The tramways and light railways purchased are to be leased to the company for a period of 21 years from the date of purchase. To facilitate the working of the Kinver Light Railway and to enable a quicker service to be run than is at present possible, the track has been doubled for a considerable distance, and the directors anticipate that the increased receipts accruing from a more frequent service will justify the capital expended. The meeting of the company was to be held yesterday.

Chelmsford Electric Lighting Co.

The report for 1905 states that the net profit is £3,817, compared with £3,869 in the preceding year. After adding balance brought forward from 1904 and providing for debenture interest, interest on loans, &c., there remains an available balance of £3,376. The connections to the mains at December, 1905, were 21,394 8-c.p. lamps, an increase of 1,832 lamps. The amount expended in repair and maintenance of machinery and mains (£477) had been charged to renewals fund account, as previously, together with £337 difference on sale of obsolete plant. The balance of renewals fund account at December 31st, 1905, was £1,665. The directors recommend a dividend at the rate of 6 per cent. per annum on the share capital, absorbing £2,235, to set aside £800 as an addition to the renewals fund account, to write off £200 from the preliminary expenses account, and to carry £241 forward.

The annual ordinary general meeting of this company was held on Wednesday at the offices of the company, Salisbury House, London, E.C.

The proceedings were conducted in private, but one of our representatives was informed that the report was adopted on the motion of the chairman, Mr. C. Jowell Tufnell, who presided.

Mansfield and District Light Railway Co.

Mr. W. S. B. McLaren presided at the second annual meeting held on May 3rd at Mansfield, and in moving the adoption of the report he said that they were now carrying passengers at a rate which, if it were maintained, would amount to something like two millions in twelve months. When they had only four and one-third miles of line open their earnings were at the rate of £101 per week. When they had seven and one-third miles open the earnings were at the rate of £205 per week; and for the nine weeks during which nine miles had been open the earnings had been at the rate of £290 per week, showing that with each extension of the system the earnings had largely increased. They had called a meeting for the 15th inst. in London to sanction still further extensions. They had an agreement with the Mansfield Corporation for paying a certain rate up to 200,000 units and another rate for any consumption above that; and he did not think it would be an unfair thing to ask the Corporation in return for further extensions, that if they increased to a large extent this consumption of their electric power, they should make a further reduction for that larger quantity. The proposal to carry coals had excited a good deal of local interest. A committee of the Corporation reported in the first instance in favour of the proposals, and the B. of T. were quite favourably inclined to it. But at a meeting of the Town Council held a week or two ago the recommendation of the committee was reversed and speeches were made of a somewhat alarmist nature, foreshadowing that they would disturb the slumbers of the population by apparently carrying vast quantities of coal the whole night long, so that nobody along the line of route would be able to sleep at all. These speeches were made under a very considerable misapprehension of the actual facts of the case. He believed that the whole of the coal that they were at all likely to carry, or to be asked to carry, would be carried without the slightest difficulty during one hour out of the 24 and probably it would be all carried between the hours of seven and eight o'clock in the morning, when nobody perhaps would be asleep, and no great amount of traffic in the streets would be inconvenienced. He trusted, therefore, that the matter would be looked into again by the committee of the Corporation and that their objections would be withdrawn. But the company under its Act had power to carry coal; it had power to carry minerals of any kind and goods traffic, and it was simply for the Corporation to determine, or assist in determining, under what regulations it could be carried. They had no power to prevent it. They had only been in operation for a few months, and up to December 31st they had earned their preference dividend. They had also earned what would have yielded a small dividend upon the ordinary shares, but they did not think it desirable to declare a dividend upon the ordinary shares for these few months' work.

Oswestry Electric Lighting and Power Co.—The annual meeting was held on Monday last week, Mr. A. Wynne Corrie presiding. The directors reported that during the year a new Lancashire boiler had been installed, the steam pipes had been rearranged, the boiler house increased in size, and the engine room improved, thus bringing the works and plant thoroughly up to date. The available balance of profit amounted to £628. The directors recommended a dividend of 4½ per cent. per annum, and that £200 be placed to reserve. The chairman said he considered the report to be the most favourable that had yet been presented. The cost of generation and distribution of electricity was £1,153 in 1904, compared with £996 in 1905. The saving of about £150 was largely owing to the reduction of the coal bill and to the managing director's skill. The sales in 1904 amounted to £2,178, compared with a decrease of £102 last year. The reason for this was that the directors had encouraged the consumers to use indicators. The company got nothing out of the indicators, but the users profited to the tune of £102. Mr. Bremner Smith, in seconding, said that the alterations, though costly, would result in increased saving in the coming year. They had been carried out to prevent waste, and they were doing this very effectually.

Sao Paulo Tramway, Light and Power Co.—The report for 1905 states that the gross earnings were $1,908,405, an increase of $489,067, or 34 per cent. The operating expenses increased by 40 per cent., and the net earnings were $1,238,473 (an increase of 31 per cent.) The dividends paid amount to 8 per cent. per annum. There was a large increase in the supply to power consumers. At Parnahyba the extension of the power house was completed, and the fifth generator and turbine were placed in position. This installation necessitated the building of a new tail race, and same was built sufficiently large to allow for the installation of two additional 5,000-h.p. units when necessary. In the sub-station at Sao Paulo there were installed a new bank of transformers and a synchronous motor-generator, working in connection with the fifth unit at Parnahyba. The high-tension switch gallery was extended to receive additional panels, and the lightning-arrester house was enlarged to permit of a better arrangement of lightning arresters and automatic switches. A storage battery plant is now being erected of sufficient capacity to operate the entire system in case of a shut-down. It is expected the battery will be in operation by May 1st next. To meet the increased demand upon the service, it was found necessary to construct additional track mileage of over 12,000 ft.

South London Electric Supply Corporation.—The company reports having sold during the quarter ended Lady Day last, 2,682,815 units, realising £21,000. The figures for the corresponding quarter in 1905 were 2,457,880 units, realising £20,640.

Castner-Kellner Alkali Co.—The report for the year ended March 31st shows a net profit of £68,847, plus £12,798 brought forward; £30,000 is to be appropriated to depreciation reserve, increasing it to £115,000; a dividend at the rate of 8 per cent. per annum is to be paid for the last six months, making, with the interim dividend, 6 per cent. for the year, leaving £14,548 to carry forward; £5,000 has been employed in reduction of the debenture debt.

Submarine Cables Trust.—From the report for the year ended April 15th, it appears that the revenue was £25,058, and the expenses £1,153, leaving £23,905. After providing £18,962 to meet payment of the coupons, £4,921 has been transferred to redemption fund, leaving £115 to carry forward.

Calcutta Electric Supply Corporation.—The report for 1905 shows that there was an increase of 28½ per cent. in the number of units sold. The gross revenue from all sources amounted to £73,472, the working costs, including a provision for renewals, were £38,871, and the net revenue was £33,720. The capital expenditure was increased by £73,774 during the year. In view of the capital outlay, the amount set aside for renewals fund has been increased from £11,000 to £15,000. The sum of £5,477 has been expended in repairs and renewals, £628 has been written off, and £31,590 is carried forward as a reserve for renewals. The directors recommend a final dividend at the rate of 10½ per cent. per annum for the half year, making, with the interim dividend, 8½ per cent. for the year, and £4,649 is carried forward.

Kobe Electric Light Co.—The *Anglo-Japanese Gazette* says that the report for the six months to December 31st shows a net profit of Y32,390. Of this sum Y3,000 is placed to reserve fund. A dividend at the rate of 10 per cent. per annum is recommended.

Stock Exchange Announcements.—Applications have been made to the Committee to appoint a Special Settling Day in and to grant a quotation to—

Manx Electric Railway Co.—22,900 five-and-a-half per cent. cum. pref. shares of £5 each, fully paid, and scrip (fully and partly paid) for £200,000 Four-and-a-Half per Cent. First Mortgage Debenture stock.

And to allow the following securities to be quoted in the Official List:—

Urban Electric Supply Co., Ltd.—Further issue of 30,000 Ordinary shares of £5 each, fully paid, and 20,000 five per cent. cum. pref. shares of £5 each, fully paid.

St. James' and Pall Mall Electric Light Co.—For the quarter ended Lady Day the company sold 2,377,044 units, estimated to produce £32,684, as against 2,332,361 units, which produced £33,333, for the corresponding period of last year.

Craigpark Electric Cable Co.—The accounts for the year ended March last, showed a profit, including £1,018 brought forward, of £5,964. Out of this sum an interim dividend of 6 per cent. was paid to preference shareholders for the half-year ending September 30th last, and the directors now recommend that £304 should be written off preliminary expenses and £1,000 written off for depreciation; that £1,500 should be appropriated to pay a 4 per cent. dividend on the ordinary shares for the year, and that £911 be carried forward.

Wolverhampton District Electric Tramways, Ltd.—The report for 1905 states that the total revenue amounted to £22,312, and after deducting expenses, including debenture interest, repairs and maintenance and depreciation, there remains a profit of £2,132, plus £607 brought forward. The directors recommend that £500 be placed to reserve fund, and that a dividend at the rate of 1¼ per cent. per annum be paid on the ordinary shares, leaving to be carried forward £242. In association with the other tramway companies, whose lines are operated by the joint committee, a parcels and goods carrying business was commenced on November 1st last, and up to the present has met with considerable success.

Prospectus.—*Mexican Consolidated Electric Co., Ltd.*—Subscriptions have this week been invited by the Bank of Scotland for $7,500,000 of general consolidated first mortgage gold bonds (5 per cent.) at £93 10s. per $500 bond. The object of the company is to acquire and consolidate the tramway systems in the city of Mexico, and the surrounding Federal district. The company has acquired the controlling interest in the capital and debentures of the Mexico Electric Tramways, Ltd. There are 160 miles of track in operation (90 of which are electric), and there are 600 cars. The steam-power station already working has a capacity of 3,200 kw., and a contract has been made with the Mexican Light and Power Co., Ltd., for supply of hydro-electric power up to 7,500 h.p.; 4,000 kw. of motor-generator and sub-station plant are constructing. This plant will be ready by October 1st this year, and thereafter the steam-driven station will be used only in emergencies. As steam coal costs 36s. per ton, a great saving in operating expenses is expected.

West Coast of America Telegraph Co.—The report for 1905 states that the gross receipts were £50,808, as against £42,337 in 1904. The working expenses were £31,114, as compared with £28,118. After providing for interest on debentures and income bonds, £10,000 is placed to the general reserve and £2,000 to the maintenance ship's reserve, leaving £1,661 to carry forward.

West India and Panama Telegraph Co.—The directors have decided to recommend a dividend of 4s. per share on account of arrears of dividend on the first preference shares.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Fortnight ended.	Receipts for the fortnight. £	£*	No. of wks.	Total to date. £	£*	Route miles open.	*
Aberdeen	May 5	2,481	— 62	49	65,855	— 987	14·4	..
Ayr	Apr. 28	596	— 25	49	13,895	+ 12	8	..
Bath	May 5	1,332	— 1.3	18	12,265	+ 1,934	13	..
Belfast	,, 4	6,066	+1,063	18	54,340	+13,724	40	+ 6½
Birkenhead	,, 6	2,044	— 46	5	5,420	+ 185	13·5	..
Blackburn	,, 2	1,713	— 607	5½	5,767	+ 542	13·75	..
Blackpool Corp.	,, 3	939	—1,551	5	4,078	+ 372	11·87	..
,, —Fleetw'd	,, 5	389	— 537	18	4,909	+ 236	8·25	..
,, —Lytham	,, 3	485	— 506	26	5,184	+ 685	7½	..
Bolton	,, 6	3,749	— 7	5	10,886	+ 423	26	+ 1
Bournemouth	,, 2	2,948	+ 195	4½	7,712	+ 2,295	17·4	+ 7½
Bradford	,, 5	8,150	—1,404	5	22,815	+ 1,397	53	..
Brighton	,, 6	1,608	— 428	5	4,724	..	9·5	..
Bristol	,, 4	9,211	—1,177	..	..	..	28·5	..
Brit. Elec. Trac. Co								
Airdrie	Apr. 27	441	+ 36	17	3,650	+ 379	3·65	..
Barrow	,, 27	499	— 68	,,	3,616	+ 232	5·37	..
‡Birmingham (City)	,, 27	11,293	— 907	,,	87,972	— 4,462	14·5	..
Birmingham (Mid.)	,, 27	3,127	— 991	,,	23,440	— 6,333	12·25	..
Devonport	,, 27	933	— 72	,,	7,083	— 350	8·85	..
Dudley—Sto'rb'ge	,, 27	2,101	+ 54	,,	18,222	+ 313	21·25	..
Gateshead	,, 27	1,947	— 11	,,	15,533	+ 787	11·25	..
Gravesend, N'fleet	,, 27	549	+ 29	,,	3,508	+ 164	6·5	..
Greenock	,, 27	1,324	+ 37	,,	10,028	+ 744	7·25	..
Hartlepool	,, 27	601	+ 37	,,	4,387	+ 267	6·72	..
Leamington	,, 27	406	+ 281	,,	2,402	+ 1,117	3	..
Merthyr	,, 27	463	— 29	,,	3,106	— 30	2·9	..
‡Metropolitan	,, 27	7,880	+2,722	,,	50,701	+16,738	22	..
Middleton	,, 27	885	+ 49	,,	5,178	+ 370	8·5	..
Oldham — Ashton	,, 27	1,274	— 32	,,	8,932	+ 832	9·13	..
Peterborough	,, 27	305	— 39	,,	1,790	— 103	5·31	..
Potteries	,, 27	3,728	+ 157	,,	29,431	+ 1,637	29	..
Rothesay	,, 27	468	+ 111	,,	1,378	+ 299	2·75	..
Southport	,, 27	779	+ 57	,,	4,329	+ 120	8·17	..
South Staffs.	,, 27	1,888	+ 253	,,	18,291	+ 2,086	13·87	..
Swansea	,, 27	1,830	+ 369	,,	12,600	+ 4,247	5·5	..
Tynemouth	,, 27	566	+ 47	,,	3,085	+ 1	3·75	..
Weston-s-Mare	,, 25	290	+ 68	,,	744	+ 55	3	..
Wolverhampton D.	,, 27	1,033	+ 139	,,	6,565	+ 596	14·75	..
‡Worcester	,, 27	633	— 36	,,	4,120	— 967	5·75	..
Yorks. Wool. Dist.	,, 27	2,058	+ 538	,,	14,131	+ 4,386	17	..
Miscellaneous	,, 27	4,532	+ 127	,,	60,210	+ 673	..	..
Burnley	May 5	2,224	+ 144	..	..	..	7·5	..
Burton-on-Trent	,, 6	567	— 94	5	1,524	— 92	8·5	..
Bury	Apr. 29	1,773	..	4	4,106	..	10·5	..
Cardiff	,, 28	4,193	— 152	4	8,086	— 501	15·87	..
Carlisle	May 5	342	— 96	18	2,942	+ 90	..	..
Chatham and Dist.	,, 3	1,184	— 291	18	10,551	— 212	9·33	+ 8
Colchester	Mar. 7	327	— 5	31	5,660	..	7½	+ ½
Cork	May 3	856	— 116	18	7,515	— 33	9·89	..
Darlington	,, 5	387	— 38	5	1,018	+ 33	4·87	..
Darwen	,, 4	462	— 39	5	1,243	+ 16	4·36	..
Dover	,, 5	388	— 63	5	1,159	+ 90	4·75	+ 1½
Dublin	,, 4	9,677	— 793	18	82,293	+ 1,855	48·5	+ ·5
Dundee	,, 2	1,955	+ 285	50	47,519	+ 5,030	12·5	..
East Ham	,, 5	1,634	— 63	5	4,707	+ 710	8	+ ½
Exeter	,, 4	483	— 185	5	1,366	+ 30	4·25	..
Glasgow	,, 5	32,014	+1,057	48	752,171	+50,651	79·5	+ 6
†Gloucester	Feb. 21	221	+ 12	..	..	..	15	..
Halifax	May 2	2,613	— 760	5	7,650	+ 471	37	+ 1·5
Hastings	Apr. 26	1,258	..	..	..	..	..	..
†Huddersfield	May 5	1,329	+ 70	5	7,514	+ 867	28	..
Hull	,, 5	4,148	— 154	5	11,073	— 73	13	..
‡Ilford	Apr. 28	425	— 121	4	2,094	+ 192	6·37	..
Ilkeston	May 2	209	— 50	5	589	— 4	3·5	..
Ipswich	,, 5	691	— 184	5	2,033	+ 8	10·5	..
Isle of Thanet	,, 5	751	— 383	18	5,250	— 245	11	..
Kilmarnock	,, 5	282	— 30	51	7,836	..	4·12	..
Kirkcaldy	,, 2	470	— 15	..	..	..	7·5	..
Lan'kshire Trm.Co.	,, 3	1,805	+ 313	18	14,983	+ 3,413	12·5	+ 3·9
Leeds	Apr. 28	12,856	..	4	24,947	+ 1,672	89·5	+ 8
Leicester	May 5	4,083	— 274	18	37,068	+ 3,840	..	..
†Leith	,, 5	445	+ 247	50	19,317	..	6	+ 1
Liverpool	Apr. 28	21,583	—1,823	17	175,683	+ 5,537	104	+ 1
‡†L.C.C.	,, 21	28,968	+4,466	3	83,410	+ 7,585	99·5	—1·1
London United	May 4	10,991	—1,809	18	94,328	+ 5,670	..	..
Lowestoft	,, 5	230	— 78	32	4,112	— 128	3·5	..
Manchester	,, 6	24,224	— 657	5	65,041	+ 3,578	84	..
Nelson	..	..	..	..	..	..	..	..
Newcastle	,, 5	7,359	— 486	5	19,809	+ 837	25·5	..
Newport	,, 5	1,283	— 141	5	3,067	+ 168	14·5	+ 1·5
Northampton	,, 4	749	— 206	5	2,028	+ 41	5·5	..
Oldham	,, 6	3,172	— 103	6	10,446	+ 455	23·75	+ 1·6
‡Pontypridd	Apr. 28	142	— 25	4	758	— 43	3·5	..
Portsmouth	May 5	3,120	—1,004	5	9,357	— 115	14·5	..
Preston	,, 2	1,362	— 23	..	..	..	10	..
Reading	,, 3	1,092	— 199	5	2,949	— 3	7·5	..
Rochdale	,, 5	1,741	+ 537	5	5,171	+ 2,285	21·2	+ 5·8
Rotherham	,, 3	845	— 98	5	2,292	+ 189	9·3	..
Salford	Apr. 30	7,944	— 862	4	18,745	+ 163	38·9	..
Sheffield	May 6	9,719	— 61	6	30,614	+ 1,916	35·75	+ 1·5
‡Southampton	,, 2	884	— 43	4½	4,185	+ 131	..	..
Southend-on-Sea	,, 2	581	— 182	5	1,256	+ 69	6	..
‡Stalyb'dge,Hyde,&c	Apr. 21	807	+ 100	3	2,456	..	21	..
Stockport	,, 27	2,049	+ 722	4	3,778	+ 1,495	15·5	+ 4
Sunderland	May 6	2,418	— 136	5	6,753	+ 484	10·87	..
Swindon	,, 2	324	— 89	5½	877	— 30	4·4	..
Tyneside	,, 2	720	— 331	18	6,800	+ 435	8·87	..
Warrington	Mar. 29	677	+ 43	52	17,804	+ 1,247	6·37	+ ·25
West Ham	May 3	3,966	+ 681	5	11,305	+ 4,562	14·7	+ 8½
Wolverhampton	,, 2	467	..	..	..	..	10	..
†Yorks. W. Riding	Apr. 29	719	— 282	17	12,486	..	..	..
Baker St.-Waterloo	May 5	2,818	..	8	11,889	..	3·25	..
Cen. London Rly.	,, 5	13,491	— 79	18	122,821	— 4,091	6	..
City & S. Lon. Rly.	,, 6	5,435	— 127	18	52,094	+ 67	6·25	..
Dublin-Lucan Rly.	,, 4	196	— 64	18	1,741	— 94	7	..
G. N. and City Rly.	,, 5	3,562	+ 203	18	32,466	+ 1,276	3·5	..
L'pool Overh'd Rly.	,, 6	2,754	— 505	18	25,088	— 1,890	6·65	..
Mersey Railway	,, 5	3,450	+ 16	18	30,877	+ 1,662	4·5	..
Metropolitan Rly.	,, 6	80,909	—4,890	18	996,574	—12,817	70·5	..
Met. District Rly.	,, 6	15,817	+1,447	18	143,186	+ 8,240	24	..
Anglo-Argentine	,, 6	30,598	+2,657	18	270,282	+27,519	48	..
§Auckland	Apr.	10,083	+ 901	17	41,375	+ 2,211	18·64	..
§Brisbane	,,	11,452	+1,627	..	..	..	..	..
§Brit. Columbia Rly.	Mar.	14,746	+3,307	39	141,961	+37,294	..	..
Bu'n's A'r's E.T. Co.	Apr. 7	2,771	+ 553	14	19,791	+ 4,342	24	..
Bu'n's A'r's-Bigr'no	,, 29	7,168	+ 265	17	60,398	+ 4,563	..	..
Calcutta	May 5	5,705	+ 809	..	..	..	..	..
§Cape Electric T. Ld.	Mar.	16,198	..	..	..	..	..	..
§Geneva	,,	6,486	..	..	..	..	..	..
Perth (W.A.)	May 4	2,951	+ 17	18	27,443	+ 1,825	24·25	+ 5½

Compared with the corresponding period of 1905. † One week only.
* Includes horse, steam and other receipts. § One month.

STOCKS AND SHARES

Wednesday Afternoon.

MONEY has again assumed the paramount position as the principal influence affecting markets. On Monday the Stock Exchange talked of a 5 per cent. Bank Rate, and Consols dipped beneath 89. Since then, apprehension has been somewhat allayed by reported movements of gold from Paris to the United States, and the tone of the markets became more confident. There is no real settlement of public confidence, however, and the consequence is seen in the pronounced disinclination of investors to trust their money to stocks and shares. A few new issues appear from time to time, but there are dozens more awaiting days less unpropitious for an appeal to the public's pockets. The 5 per cent. gold bonds of the Mexican Consolidated Electric Company, offered at 91 per cent., are a very fair speculative investment; the directors are not the sort of men likely to allow their names to be associated with the concern if it had not a clean chance of prosperity. On the other hand, the Electrobus shareholders who want their money back can get it by applying, which is an honest step for the board to make. Applicants should thankfully grasp the opportunity thus held out to them of obtaining the return of their subscriptions.

Pronounced flatness remains the feature of the market in Underground Railway stocks. The decline, even since the end of last year, has now assumed serious proportions, as can be seen most readily by a tabular statement:—

Stock.	Dec. 30, 1905.	Now.	Fall.
Baker Street and Waterloo Debenture	101	95	6
Central London Ordinary	94	90	4
,, ,, Preference	102	100	2
,, ,, Deferred	86½	80½	6
Charing Cross Debenture	97½	94	3½
City and South London	45	42	3
Great Northern and City Preference	5½	3½	1½
Great Northern Piccadilly Debenture	98½	94	4½
Waterloo and City	95½	100½	+5

For the rise in Waterloo and City stock there is of course a reason quite distinctive as a market cause. When we come to the list of the Metropolitan and the District Railway stocks, the fall is still more pronounced, as may be thus seen:—

Stock.	Dec. 30, 1905.	Now.	Fall.
Metropolitan Consolidated	87	69½	17½
,, 3¼ Debenture	103	102	1
,, 3½ "A" Debenture	101	101	—
,, 3½ Preference	101	96	5
,, 3½ "A" Preference	100	95	5
,, Consolidated Preference	103	94½	8½
District Ordinary	35½	24	11½
,, 6 Debenture	151½	153	+ 1½
,, 4 Debenture	102	102	—
,, 4 Debenture, 1903-5	101	101	—
,, 5 *ex* Preference	86	69	17
,, ,, ,, (Assent)	72½	72½	—

With reference to the last stock in the list, the 5 per cent. Assented Extension Preference of the District Company, it must be remembered that the interest is guaranteed by the Electric Railways Company of London.

Turning from this extremely flat subject, we come upon more peace—albeit, perhaps, of a rather hollow kind—in the Electric Lighting list. Once more the prices present an almost unbroken array of changelessness. Metropolitan Ordinary are ½ lower at 8½, and beyond this, no alteration is to be noted. Business in the shares is very quiet, and there is a disposition upon the part of proprietors to await further L.C.C. developments before buying or selling.

Were it not for the vagaries of the Anglo-American group the Telegraph section would also command little general interest. But Anglo "A" makes an excellent gambling-counter, however dull the days, and the strength of the stock is well maintained, another 1¼ advance having taken place. The Ordinary, however, has parted with the rise of a point which it annexed last week. Indo-Europeans fell 2, the price now being 57, the decline being connected with the impression that shares perhaps held by Mr. W. S. Andrews (who died last Friday) might come to market. Eastern Ordinary is down 1, and the drop in Great Northerns is continued to a similar extent. West Coast of America gained ¼ to 16s. 3d., and at 8¼ West India and Panama Prefs. are the fraction lower. The former movement is due to the growing prosperity of the company, as disclosed in the report just out. Submarine Cables Trust Certificates remain about 127½, although the accounts for the year are good, showing an increase of some £800 in the net profits. Globe Telegraph Preference have receded to 14⅞. The annual report is very fairly good. Telephone issues call for no comment, National Second Preferences losing 10s., and the Third Preference putting on half-a-crown to 5½. The 4 per cent. Debenture stock improved slightly.

Manufacturing descriptions exhibit a little irregularity. Telegraph Constructions are a pound lower, and British Aluminium a shade harder. The Welsbach Incandescent announces a dividend on its ordinary shares of 5 per cent., but the figures shown in the report are not so good as those of the previous year.

With regard to traction issues, all there is to say can be summed up in noticing ⅛ fall in Anglo-Argentine Tramways Ordinary to 8⅞, ⅛ rise in Calcuttas to 9⅛, and a fall of 10s. in Potteries Preference to 8½. The market in Potteries shares being very narrow, it does not take much offering or bidding to alter the quotations of the shares.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last four years.				Closing Quotations May 2nd.	Closing Quotations May 9th.	Business done week ended May 9th, 1906.		Rise + or Fall —
			1902.	1903.	1904.	1905.			Highest	Lowest.	
17,700	African Direct Telegraph, 4 % Debs...	100	4 %	4 %	4 %	4 %	99 —102	99 —102	..	..	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	..	3⅜— 4½	3⅜— 4½	..	..	..
155,600‡	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	Nil	Nil	Nil	5 %	83 — 88	83 — 88	84½	..	..
702,600	Anglo-American Telegraph	Stock	60/6	61s.	22½	31½	67 — 69	66 — 68	67½	66¼	—1
3,148,700	Do. do. do. 6 % Pref.	Stock	6 %	6 %	5½	6 %	114 —115	114 —115	115½	114	..
3,148,700	Do. do. do. Deferred	Stock	1/-	2s.	Nil	⅛	22⅜— 23	24 — 24½	24½	23⅛	+1½
50,000	Anglo-Portuguese Tel., 5% Mort. Deb. Stock Red.	100	..	..	..	..	101 —103	101 —103	..	..	..
44,000	Chili Telephone, Nos. 1 to 44,000	5	6 %	7 %	8 %	..	7⅛— 8⅛	7⅛— 8⅛	8⅛	8	..
1,932,856‡	Commercial Cable Stlng. 600 year 4 % Deb. Sk. Red.	Stock	4 %	4 %	4 %	4 %	96⅜— 98⅛	96⅜— 98⅛	97½	96⅝	..
16,000	Cuba Telegraph	10	6½ %	10 %	5 %	5 %	8½— 9 xd	8½— 9 xd	8⅝	8½	..
6,000	Do. 10 % Pref.	10	10 %	5 %	10 %	10 %	17 — 18 xd	17 — 18 xd	..	..	..
12,981	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	4 %	3⅜— 3⅝	3⅜— 3⅝	..	..	..
6,000	Do. do. 10 % Cum. Pref. ..	5	10 %	10 %	10 %	10 %	8½— 9	8½— 9	..	..	..
80,000	Do. do. 4½ % Debs.	50	4½ %	4½ %	4½ %	4½ %	100 —103 %	100 —103%	..	..	..
60,716‡	Direct United States Cable	20	3½ %	3 %	3½ %	3½ %	15½ — 15⅝	15½ — 15⅝	15⅝	15⅛	..
70,000	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,200,R.	100	4½ %	4½ %	4½ %	4½ %	101 —103	101 —103	..	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	7 %	143 —146	142 —145	144½	142	—1
3,000,000	Do. 3½ % Pref. Stock	100	3½ %	3½ %	3½ %	3½ %	89 — 91	89 — 91	90⅞	90	..
1,848,772	Do. 4 % Mort. Deb. Stock Red. ..	Stock	4 %	4 %	4 %	4 %	106 —108 xd	106 —108 xd	107⅞	106	..
800,000	Eastern Extension, Australiasia, and China Tele.	10	7 %	7 %	7 %	7 %	14½ — 15	14½ — 15	14⅞	14⅜	..
752,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	105½ —107½	105½ —107½	107	..	..
800,000	East & S. Afric. Tel., 4 % Mt. Db., 1 to 8,000, red. 1909	100	4 %	4 %	4 %	4 %	99 —101	99 —101	..	..	..
200,000‡	Do. 4 % Reg. M. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	4 %	101 —103 %	100 —102 xd	..	..	..
180,887	Globe Telegraph and Trust	10	£3	5½ %	5⅝ %	5½ %	11 — 11½	11 — 11½	11 7/32	11	..
180,887	Do. do. 6 % Pref.	10	6 %	6 %	6 %	6 %	14⅜— 15⅛	14⅜— 15	..	..	— ⅛
150,000	Great Northern Telegraph, of Copenhagen ..	10	12½ %	15 %	24 %	24%	38 — 40	37 — 39	..	..	—1
42,300	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	4½%	4½%	4½%	4½%	101 —103	101 —103	..	..	..
17,000	Indo-European Telegraph	25	10 %	10 %	13 %	13 %	£8 — 60	56 — 58	57⅞	..	—2
251,127	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	Nil	1⅛— 1⅜	1⅛— 1⅜	23/1⅛	..	..
72,680	Monte Video Telephone Co., Ltd. Ord. ..	1	3 %	3 %	4 %	..	1/16— 1/16 xd	1/16— 1/16 xd	..	..	..
86,492	Do. do. do. 5 % Pref. ..	1	5 %	5 %	5 %	..	⅛— 1 xd	⅛— 1 xd	..	..	..
1,988,333	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	108 —110	108 —110	109½	108	..
1,966,667	Do. do. Def. Stock	100	4½ %	5 %	5 %	5 %	108 —110	108 —110	109	108	..
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	6 %	12 — 14	12 — 14	13⅛	12⅝	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	6 %	10⅛— 12⅛	10 — 12	12⅛	11⅛	— ⅛
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %	5⅛— 5⅜	5⅜— 5⅝	5⅝	..	+ ⅛
2,000,000	Do. do. 3½ % Deb. Stock Red. ..	Stock	3½ %	3½ %	3½ %	3½ %	98 —100	98 —100	99⅛	98½	..
1,689,598	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	103 —105	104 —106	105	104½	+1
179,312	Oriental Telep. and Elec. 1 to 171,504,fully paid	1	6 %	6½ %	6½ %	7½ %	1⅜— 1½	1⅜— 1¼	..	..	..
50,000	Do. do. do. 6 % Cum. Pref. ..	1	6 %	6 %	6 %	6 %	1½— 1⅝	1½— 1⅝	25/-	..	..
100,000	Do. do. do. 4% Red. Deb. Stock	100	..	..	..	4 %	99 —101	99 —101	100½	100½	..
100,000	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	4 %	4 %	4 %	100 —103	100 —103	..	..	..
11,899‡	Reuter's	8	5 %	5 %	5 %	5 %§	7½— 7⅝	7½— 7⅝	7⅝	..	..
60,000	Telephone Co. of Egypt, 4½ % Deb. Red. ..	100	..	..	..	4½%	103 —106	103 —106	..	..	..
3,201	Submarine Cables Trust	Cert.	6 %	6 %	6 %	6 %	126 —129 xd	126 —129	..	..	..
70,000	United River Plate Telephone	5	7 %	8 %	8 %	..	7 — 7½	7 — 7½	..	..	..
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	5 %	5⅜— 5⅝	5⅜— 5⅝	..	..	..
179,947	Do. do. 5 % Debs.	Stock	5 %	5 %	5 %	5 %	110 —112	110 —112	..	..	..
15,600‡	West African Telegraph, Shares	10	2 %	4 %	4½%	4 %	9⅜— 10½	9⅜— 10⅜	..	..	..
30,008	W. Coast of America, 1 to 30,000 & 5⅛,001 to 53,008	2½	Nil	Nil	Nil	Nil	⅜— ⅝	⅜— ⅝	16/3	..	+ ⅛
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Bras. Sub. Tel.	100	4 %	4 %	4 %	4 %	100 —102	100 —102	100	..	..
207,930	Western Telegraph, Ltd., Nos. 1 to 207,930 ..	10	7 %	7 %	7 %	5 %	14 — 14½	14 — 14½	14⅜	14⅛	..
75,000	Do. do. 5 % Debs. 2nd series, 1906	100	5 %	5 %	5 %	5 %	101 —103	101 —103	..	..	..
553,380	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	100 —103	101 —103	102½	..	+ ½
88,221	West India and Panama Telegraph	10	Nil	Nil	Nil	..	⅜— ⅝	⅜— ⅝	12/6	..	..
84,563	Do. do. 6 % Cum. 1st Pref.	10	7 %	7 %	6 %	6 %	8¼— 8⅝	8 — 8½	8½	8¼	— ⅛
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	Nil	..	6½— 7⅛	6 — 7	..	..	— ⅛
80,000‡	Do. do. 5 % Debs., Nos. 1 to 1,800 ..	100	5 %	5 %	5 %	5 %	101 —104	101 —104	..	..	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

170,000	Anglo-Argentine Trams, 260,008 to 480,007	5	..	..	8 %	8 %	8¼— 8⅜ xd	8⅛— 8⅜	8⅜	8⅛	— ⅛
260,007	Do. 6½ % Cum. Prefs., 1 to 260,007 ..	5	..	5 %	5 %	5⅛%	6⅛— 6⅜	6⅛— 6⅜	6⅜	6⅛	..
266,660	Do. Permanent, 6 % Deb. Stock, 1888	100	..	6 %	6 %	6 %	140 —143	140 —143	141½	141½	..
285,100	Auckland E. Trams., 5 % 1st Mort. Deb. Stock ..	100	..	5 %	5 %	5 %	104 —106	104 —106	..	..	..
800,000	Babcock & Wilcox, 1 to 580,000	1	..	17 %	20 %	20 %	3¾— 4	3⅞— 4	80/-	77/6	..
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	..	6 %	6 %	6 %	1½— 1⅝ xd	1½— 1⅝ xd	£1/3	..	..
38,000	British Aluminium, Ord., 2,001 to 40,000	5	..	..	7 %	7 %	2⅛— 2⅜	2⅜— 2⅝	£1/3	48/9	+ 1/16
40,000	Do. do. 7 % Cum. Pref...	5	Nil	Nil	7 %	7 %	6— 6⅛	6 — 6⅛	6½	6 7/16	..
20,000	Do. do. "A" 6 % Cum. Pref.	5	Nil	Nil	6 %	6 %	5⅛— 5⅜	5⅛— 5⅜	..	..	..
20,000	Do. do. 4 % Funding Certs.	5	..	..	4 %	4 %	3¾— 4⅛	3⅞— 4⅛	80/-	78/9	..
800,000‡	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	5 %	5 %	5 %	5 %	102 —106	102 —106	..	..	..
300,000	British Columbia E. Rail Def. Ord. Stock	100	..	6 %	6 %	6 %	116 —119 xd	116 —119 xd	116¼	..	..
800,000	Do. 5 % Pref. Ord. Stock	100	..	5 %	5 %	5 %	110 —118	109 —112	..	..	—1
115,000	Do. 5 % Cum. Perp. Pref. Stock	100	..	5 %	5 %	5 %	107 —110	107 —110	108½	107¾	..
240,400	Do. 4½ % 1st Mort. Debs., 1 to 6,250	40	..	4½%	4½%	4½%	101 —103	102 —104	..	..	+1
220,000	Do. 4½ % Vancouver Power Debs., 1 to 2,200	100	..	4½%	4½%	4½%	103 —106	103 —106	105½	..	..
133,301	British Electric Traction	10	8 %	6 %	6 %	..	6 — 7	6 — 7	6⅞	6 9/16	..
161,487	Do. do. 6 % Cum. Pref.	10	6 %	6 %	6 %	6 %§	8¾— 9⅜	8⅞— 9⅜	9 5/16	9	..
1,415,422‡	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	5 %	112 —115	112 —115	112	..	..
410,178	Do. do. 4½ % 2nd Deb. Stock Red.	100	..	..	4½%	4½%	93 — 95 xd	93 — 95 xd	93½	..	..
100,000	British Insulated and Helsby Cables	5	10 %	8 %	8 %	8 %	6¾— 7	6¾— 7	6½	..	..
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	6⅜— 6½	6⅜— 6½	..	..	..
500,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	4½%	4½%	4½%	4½%	104 —107	104 —107	..	..	..
212,000	British Thomson-Houston 4½ % 1st Mort. Debs. ..	100	..	4½%	4½%	4½%	96 — 98	96 — 98	..	..	..
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 475,000	5	..	6 %	Nil	..	1⅞— 2⅛	1⅞— 2⅛	40/9	£8/9	..
1,016,358	Do. do. 4 % Mort. Deb. Stock ..	100	..	..	4 %	4 %	80 — 85	80 — 85	..	..	..
50,000	¶Browett, Lindley & Co., Ord.	£1	Nil	Nil	Nil	..	13/16 to 15/16	13/16 to 15/16	..	..	..
50,000	¶ Do. do. 6 % Cum. Pref. ..	£1	Nil	Nil	Nil	..	14/6 to 15/6	14/6 to 15/6	..	..	..
105,781	Brush Electrical Engineering, Ord., 1 to 105,781 ..	2	Nil	Nil	Nil	2½%	⅝— ¾	⅝— ¾	16/3	..	..
150,000	Do. Non-cum. 6 % Pref.	2	6 %	6 %	6 %	6 %	1½— 2	1½— 2	..	..	..
125,000‡	Do. 4½ % Perp. Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	97 — 99	97 — 99	..	..	..
125,000‡	Do. 4½ % Perp. 2nd Deb. Stock	Stock	4½%	4½%	4½%	4½%	84 — 86	84 — 86	..	..	..
100,000	Buenos Ayres & Belgrano, 1 to 100,000	5	..	3 %	4 %	3 %	3¼— 3⅜	3¼— 3⅜	66/10½	..	— ⅛
40,000	Do. "A" 6 % Cum. Pref., 1 to 40,000	5	..	6 %	6 %	6 %	5⅛— 5⅜	5⅛— 5⅜	5⅜	..	..
27,500	Do "B" do. 1 to 27,500	5	..	6 %	6 %	6 %	5 — 5⅛	5 — 5⅛	..	..	..
317,700	Do. 5 % Deb. Stock	100	..	5 %	5 %	5 %	106 —108	106 —108	..	..	..
190,000	Do. 5 % 2nd Deb. Stock	100	..	5 %	5 %	5 %	102 —105	102 —105	..	..	..
105,000	Calcutta Trams., 1 to 105,000	5	..	6 %	8 %	8 %	9 — 9¼ xd	9⅛— 9⅜	9¼	9⅛	+ ⅛
32,610	Do. 105,001 to 137,610	5	..	..	..	8 %	8½— 9	8¾— 9	8⅞	8⅝	..
350,000	Do. 4½ % 1st Deb. Stock	100	..	..	4½%	4½%	106 —108	106 —108	..	..	..
35,000	Callender's Cable Construction shares	5	15 %	12½%	12½%	15%	11 — 12	11 — 12	11⅜	11½	..
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	5⅜— 6	5⅜— 6	5⅝	..	..
800,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	105¾—110½	105¾—110½	109	..	..
491,222	Cape E. Trams., 1 to 491,222	1	..	15 %	10 %	5 %§	⅛— ¼	⅛— ¼	..	..	..
450,000	Castner-Kellner Alkali, 1 to 450,000	1	..	4 %	4 %	6 %	1 1/16— 1 1/16	1 1/16— 1 1/16	23/-	22/6	..
280,211	Do. do. 4½ % 1st Mort. Deb. Stock	100	..	..	4½%	4½%	95 —100	96 —100	..	..	..
1,989,698	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	4 %	90 — 92	88 — 90	89⅜	88½	..
530,316	Do. do. 4 % Pref. Stock ..	Stock	4 %	4 %	4 %	4 %	100 —102	99 —101	101	99½	..
530,316	Do. do. Def. do.	Stock	4 %	4 %	4 %	4 %	80 — 83	78 — 81	80	..	..
1,480,000	City and South London Railway	Stock	3½%	2¾%	2¾%	1⅞%§	41 — 43	40 — 42	42⅜	41⅜	..
85,000	Crompton & Co., Nos. 1 to 85,000	8	5 %	2½%	2½%	..	2 1/16— 2 3/16	2 1/16— 2 3/16	..	..	..
100,000‡	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	..	5 %	5 %	5 %	5 %	96 — 99	96 — 99	..	..	..

pano of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. § Interim dividends.
‖ And bonus of 10s. ¶ From Manchester Share List.

Continued on next page.

SHARE LIST OF ELECTRICAL COMPANIES.—*(Continued).*

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—*(continued).*

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years. 1902.	1903.	1904.	1905.	Closing Quotations May 2nd.	Closing Quotations May 9th.	Business done week ended May 9th, 1906. Highest	Lowest.	Rise + or Fall −
260,000	Dick, Kerr & Co., 1 to 260,000	1	..	..	10 %	..	1½ — 1⅞	1½ — 1⅞	..	..	..
305,000	Do. do. 6 % Cum. Pref., 1 to 305,000	1	..	6 %	6 %	6 %	1 15/16 — 1 15/16	1 15/16 — 1 15/16	..	..	..
294,150	Do. do. 4½ % Deb. Stock	100	..	4½ %	4½ %	4½ %	104 —107	104 —107	..	..	..
60,000	Dublin United Trams. (1896), 1 to 60,000	10	..	5½ %	6 %	6 %	13⅞ — 14⅜	13⅞ — 14⅜	..	..	..
59,987	Do. 6 % Pref. between 1 and 60,000	10	..	6 %	6 %	6 %	14⅜ — 15⅛	14⅜ — 15⅛	..	..	..
63,400	Do. 4 % Debs.	100	..	4 %	4 %	4 %	99½ —100⅛	99½ —100⅛	..	..	..
800,000	Do. 3½ % "A" Debs.	100	..	3½ %	3½ %	3½ %	97⅞ — 98⅛	95 —100	..	..	— ½
800,000	Do. 3½ % "B" Deb. Stock	100	..	3½ %	3½ %	3½ %	96½ — 97⅜	95 —100	..	..	+ ½
99,261	Edison & Swan Utd., "A" shrs., £8 pd., 1 to 99,261	5	Nil	Nil	2½ 5/8	..	1⅛ — 1⅜	1⅛ — 1⅜	31/10½	..	..
17,189	Do. "A" shares, 01—017,189	5	Nil	Nil	2½ 5/8	..	2½ — 3	2½ — 3	..	..	..
844,023‡	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	86 — 88	86 — 88	..	..	..
100,000‡	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	90 — 95	90 — 95	..	..	..
112,100	Electric Construction 1 to 112,100	2	6 %	4 %	Nil	..	1 1/16 — 1 3/16	1 1/16 — 1 3/16	..	..	..
81,890	Do. do. 7 % Cum. Pref., 1 to 81,890	2	7 %	7 %	7 %	..	2 — 2⅛	2 — 2⅛	..	..	..
200,000	Do. do. 4 % Perp. 1st Mort. Deb. Stk.	Stock	4 %	4 %	4 %	4 %	89 — 92	89 — 92	..	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	5 %	..	9⅜ — 9⅝	9⅜ — 9⅝	..	..	..
200,000	Do. do. 4 % Mort. Deb.	Stock	4 %	4 %	4 %	4 %	94 — 98	94 — 98	..	..	..
78,000	Gt. N. & City Rail Pref. Ord. "A" 4 % 1 to 78,000	10	..	3 %	4 %	4 %	3⅜ — 4¼	3⅛ — 3⅜	..	..	— ⅛
96,000	Greenwood & Batley 7 % Cum. Pref.	10	..	7 %	7 %	7 %	10⅜ — 11¼	10⅜ — 11¼	..	..	..
80,000	Do. do. 5 % Mort. Debs.	100	..	5 %	5 %	5 %	100 —102	100 —101	..	..	— ⅛
200,000	Henley's (W. T.), Telegraph Works, Ord.	5	20 %	15 %	15 %	15%	12½ — 13½	12½ — 13½	13	12⅞	..
200,000	Do. do. 4½ % Pref.	5	4½ %	4½ %	4½ %	4½%	5⅛ — 5⅜	5⅛ — 5⅜	..	..	..
41,978	Do. do. 4½ % Mort. Deb. Stock	Stock	4½ %	4½ %	4½ %	4½%	109 —111	109 —111	..	..	..
108,022	Do. do. Scrip. 50 % paid	..	..	..	..	..	57⅛ — 59⅛	57⅛ — 59⅛	58¼	57⅛	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works	10	10 %	10%	5 %	10%	17 — 18	17 — 18	17⅝	17 1/16	..
87,500	‡Liverpool Overhead Railway, Ord.	10	1½%	1½%	1½%	Nil	1⅜ — 1⅝	1⅜ — 1⅝	..	..	..
10,000	† Do. do. Pref. £10 paid	10	5 %	5 %	5 %	5 %	6½ — 7	6½ — 7	..	..	..
600,070	London United Trams (1901), 1 to 60,007	10	..	8 %	6 %	3 %	7⅛ — 8½	7 — 9	..	..	..
399,930	Do. do. 60,008 to 100,000 (£4 paid)	10	..	8 %	6 %	3 %	1½ — 2½	1½ — 2½	..	..	..
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	..	5 %	5 %	5 %	9½ — 9¾	9½ — 9¾	9⅝	..	..
1,331,000	Do. do. 4 % 1st Mort. Deb. Stock	100	..	4 %	4 %	4 %	96 — 99	96 — 99	99	96	..
314,016	Metropolitan Electric Trams, Defd.	1	Nil	Nil	Nil	3 %	½ — ½	½ — ½	3/6	..	..
500,000	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	¾ — 1	¾ — 1	18/9	..	..
350,000	Do. 4½ % Deb. Stock Red.	100	..	..	4½ %	4½ %	102 —104	102 —104	..	..	..
20,000	Peebles (B.) & Co. 6 % Cum. Pref., 20,001 to 40,000	5	..	..	6 %	6 %	5⅛ — 5⅜	5⅛ — 5⅜	..	..	..
24,500	Potteries E. Tro., 20,001 to 40,000 & 50,001 to 54,500	10	..	5 %	5 %	4 %	8 — 9	8 — 9	8	..	..
24,500	Do. 5 % Cum. Pref., 1 to 20,000 & 40,001 to 44,500	10	..	5 %	5 %	5 %	8⅞ — 9⅛	8 — 9	8⅝	..	— ⅛
245,000	Do. 4½ % Deb. Stock	100	..	4½ %	4½ %	4½ %	103 —106	103 — 106	..	..	..
37,350	Telegraph Construction and Maintenance	12	20 %	20 %	15 %	15 %	33 — 35	32 — 34	..	..	—1
150,000‡	Do. 4 % Deb. Bds., 1 to 1,500 Red. 1909	100	4 %	4 %	4 %	4 %	101 —103	101 — 103	..	..	..
3,599,200	Undergd. E. R., Lon., 5 % Profit Shar. S. Nts.	..	..	..	5 %	5 %	97 — 99	96 — 98	..	..	—1
640,000	Waterloo & City Railway, Ord. Stock	100	3½%	3½%	3½%	3½%	100 —103	99 — 102	..	..	—1
66,666	Willans & Robinson, 1 to 30,000 & 80,001 to 116,666	5	3⅓%	3 %	Nil	Nil	1⅜ — 2½	1⅜ — 2½	..	..	..
66,666	Do. 6 % C. P., 30,001 to 80,000 & 125,001 to 141,666	5	..	6 %	Nil	Nil	3⅜ — 4	3 — 3⅜	..	..	— ⅛
246,806	Do. 4 % 1st Mort. Deb. Stock	100	..	4 %	4 %	4 %	80 — 85	80 — 85	..	..	..

ELECTRICITY SUPPLY COMPANIES.

14,000	Bromley (Kent) E.L. & P., 1 to 14,000	5	..	5 %	5⅛%	4 ⅝%	5⅛ — 5⅜	5⅛ — 5⅜	..	..	..
50,000	Do. do. 4½ % 1st. deb. stock	100	..	4½%	4½%	4½%	101 —104 xd	101 —104	101½	..	..
29,377	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	5	8 %	10 %	10 %	10 %	8¾ — 9¼	8¾ — 9¼	8⅝	8¼	..
10,623	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	8¾ — 9¼	8¾ — 9¼	..	..	..
300,000	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	4 %	102 —105	102 —105	..	..	..
80,000	Charing Cross and Strand Electricity Supply	5	10 %	8 %	8 %	5 %	4 — 5	4 — 5	87/6	88/9	..
80,000	Do. do. do. 4½ % Cum. Pref.	5	4½%	4½%	4½%	4½%	4⅜ — 4⅝	4⅜ — 4⅝	..	..	..
40,000	Do. "City Undertaking" 4½ % Cum. Prf.	5	4½%	4½%	4½%	4½%	4 — 4½	4 — 4½	..	..	..
40,000	Do. do. 1908	5	..	4½%	4½%	4½%	4 — 4½	4 — 4½	..	..	..
420,000	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	101 —103	101 —103	102	..	..
44,436	Chelsea Electricity Supply, Ord.	5	4½%	5⅛%	6 %	6 %	5⅛ — 5⅜	5⅛ — 5⅜	..	..	..
175,000‡	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	107 —109	107 —109	..	..	..
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	10	5 %	5 %	6 %	6 %	10¼ — 11	10¼ — 11	10 2/16	..	..
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	6 %	13 — 14	13 — 14	..	..	..
400,000‡	Do. 5 % Db. Stk., Scrip. (iss. at 115) all pd.	..	5 %	5 %	5 %	5 %	123 —126	123 —126	..	..	..
800,000	Do. 4½ % 2nd Db. Stk., Prov. Crts., all pd.	100	4½%	4½%	4½%	4½%	101 —103	101 —103	102	101	..
40,000	County of Durham Electrical Power, Ord.	2	4 %	4 %	£8 7 0	4 %	2⅞ — 3⅛	2⅞ — 3⅛	..	..	..
50,000	Do. do. do. 5 % Pref.	5	5 %	5 %	5 %	5 %	5 — 5⅛	5 — 5⅛	..	..	..
40,000	County of London Electric Lighting, Ord. 1—40,000	10	4 %	4 %	4½%	5 %	8 — 9	8 — 9	..	..	..
80,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	6 %	11⅛ — 12⅛	11⅛ — 12⅛	11⅛	..	..
400,000‡	Do. do. 4½ % Deb. Stock	..	4½%	4½%	4½%	4½%	109 —112	109 —112	..	..	..
400,000	Do. do. 4½ % 2nd Deb. Stock	Stock	4½%	4½%	4½%	4½%	99 —101 xd	99 —101	..	..	..
80,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	7 %	5 ⅝%	3⅜ — 4⅛	3⅜ — 4⅛	75/-	..	..
80,000	Do. do. 6 % Cum. Pref.	..	6 %	6 %	6 %	6 %	5 — 5⅛	5 — 5⅛	5⅛	..	..
320,000	Do. do. 4½ % 1st Mort Deb. Stk	100	4½%	4½%	4½%	4½%	103 —106	103 —106	104	..	..
10,000	Folkestone, 1 to 10,000	5	..	5⅛%	5⅛%	5½%	5⅛ — 5⅜	5⅛ — 5⅜	..	..	..
10,000	Do. 5 % Cum. Pref., 1 to 10,000	5	..	..	..	5 %	5 — 5⅛	5 — 5⅛	..	..	..
75,000	Do. 4½ % 1st. Deb. Stock	100	..	4½%	4½%	4½%	101 —104	101 —104	..	..	..
13,000	Hove, 1 to 13,000	5	..	8½%	8½%	9 %	8¼ — 8⅝	8¼ — 8⅝	..	..	..
10,000	Do. New (£6 10s. paid)	£3	..	8½%	8½%	9 %	8⅛ — 9	7 — 8	..	..	..
87,300	Do. 4 % Deb. Stock	100	..	4 %	4 %	4 %	98 —100	96 — 99 xd	..	..	..
7,300	Do. 4½ % Deb. Stock	100	..	4½%	4½%	4½%	98 —100	96 — 99 xd	..	..	..
21,000	Kensington and Knightsbridge Electric Ord.	5	10 %	12½	12 %	10 %	9½ — 10½	9½ — 10½	..	..	..
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	98 —101	98 —101	..	..	..
111,000	London Electric Supply Corporation, Limited, Ord.	3	Nil	Nil	3 %	4 %	2 — 2½	2 — 2¼	48/9	45/6	..
60,000	Do. do. do. 6 % Pref.	5	6 %	6 %	6 %	6 %	5 — 5⅛	5 — 5⅛	5⅛	..	..
874,395	Do. do. 4 % 1st Mort. Deb. Stock	Stock	4 %	4 %	4 %	4 %	98 —101	98 —101	100	99½	..
200,000	Metropolitan Electric Supply, 1 to 100,000	5	7½%	8½%	10 %	10 %	8¾ — 9½	8 — 9	8⅝	8¼	— ½
76,121	Do. 4½ % Cum. Pref. 1—71,106, £3 pd.	5	4½%	4½%	4½%	4½%	5⅛ — 5⅜	5⅛ — 5⅜	5 5/16	5⅛	..
200,000‡	Do. 4½ % 1st Mort. Deben. Stock	..	4½%	4½%	4½%	4½%	110 —114	110 —114	..	..	..
250,000‡	Do. 3½ % Mort. Deben. Stock Redem.	Stock	3½%	3½%	3½%	3½%	95 — 97	95 — 97	..	..	..
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	4½%	101 —103	101 —103	102½	..	..
75,000	Newcastle-on-Tyne, 1 to 75,000	5	..	8 %	8 %	8 %	7¼ — 7⅝	7¼ — 7⅝	..	..	..
75,000	Do. 5 % Pref., 1 to 75,000	5	..	5%	5 %	5 %	6 — 6½	6 — 6½	..	..	..
10,852	Notting Hill Electric Lighting	10	6 %	6 %	7 %	7½%	13 — 14	13 — 14	..	..	..
64,000	Do. do. 4 % 1st Mort.Deb.	100	4 %	4 %	4 %	4 %	97 — 99	97 — 99	..	..	..
18,500	Oxford, 1 to 96 and 407 to 18,810	5	..	6½%	7 %	7 %	6½ — 7	6¼ — 7	..	..	..
50,000	Do. 4 % Deb. Stock	100	..	4 %	4 %	4 %	99 —101	99 —101	..	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	12½%	9 — 10	9 — 10	9⅛	9½	..
20,000	Do. do. 7 % Pref. 20,081 to 40,080	5	7 %	7 %	7 %	7 %	7 — 8	7 — 8	7⅛	..	..
150,000‡	Do. do. 3½ % Deb. Stock Red.	100	3½%	3½%	3½%	3½%	96 — 98	96 — 98	..	..	..
12,000	Smithfield Markets Electric Supply, Ord.	5	2½%	4 %	4 %	4 %	2½ — 2⅝	2½ — 2⅝	..	..	..
50,000	Do. do. do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	76 — 80	76 — 80	..	..	..
65,000	South London Electricity Supply, Ord.	5	12½	3 %	4 %	4 %	3 — 3½	3 — 3½	66/3	..	..
103,700	South Met. Elec. Lt. & Power (Ord.	1	Nil	Nil	Nil	2½%	⅜ — ½	⅜ — ½	..	..	..
85,368	*(Late Blackheath and Greenwich* 7 % Pref.	1	Nil	7 %	7 %	7 %	1⅛ — 1⅜	1⅛ — 1⅜	..	..	..
148,292	*Dist. E.L.Co.)* 4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	4½%	103 —106	103 —106	..	..	..
50,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	5 %	4⅛ — 4⅜	4⅛ — 4⅜	87/6	85/-	..
80,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	4 1/16 — 4 3/16	4 1/16 — 4 3/16	97/6	96/10½	..
200,000	Do. do. 4½ % 1st Mort. Db. Stk. Red	100	..	..	4½%	4½%	102 —104	102 —104	103	102	..
110,000	Westminster Electric Supply, Ord.	5	12 %	13½%	14 %	13 %	9⅛ — 10⅛	9⅜ — 10⅛	9⅝	..	..
28,151	Do do. 4½ % Cum. Pref. (Originally 5 %—Red. to 4½ % from 31st Dec., 1905.)	5	5 %	5 %	5 %	5 %	5 5/16 — 5 5/16	5 5/16 — 5 5/16	5 5/16	5 5/16	..

Shares not officially quoted :—Mackay Companies, ord., 65—66. Pref. 74—75.

† Unless otherwise stated all shares are fully paid. ‡ Interim dividends.

(Bank rate of discount 4 per cent. (May 3rd, 1906).

PARLIAMENTARY.

L.C.C. Tramways.

(*Continued from page* 709.)

WEDNESDAY, MAY 2ND.

On Wednesday, May 2nd, Mr. HARPER, the statistical officer of the L.C.C., was called and gave evidence in support of the proposed tramway from Cricklewood to the Marble Arch. He considered that the present means of locomotion along the route was not sufficient to accommodate the traffic. The population at the Cricklewood end of the route was growing, and this would lead to a great deal of traffic for shopping purposes in the west end of London. During the rush hours of the morning and evening there were not sufficient 'buses to cope with the traffic, but it might be that at certain hours there were too many.

In cross-examination, WITNESS admitted that the railway companies serving the district gave good facilities, but that did not do away with the fact that there was no tramway communication. He agreed that there was an increasing number of motor-omnibuses using the route, and probably if the tramway was constructed some of these would be driven off.

Mr. FELL, chief officer of the London County Council tramway department, said it was proposed to give a two-minute service over the route. The present omnibus fares for the whole journey were 3d., while the tramway fare proposed would be 2d. The 'buses gave no workmen's fares, but special cars would be provided for workmen on the tramways.

In answer to Mr. GREIG, who represented the Willesden Urban District Council, WITNESS said that as the result of the agreement which had been come to between the Middlesex and the London County Councils, certain widenings proposed by the Middlesex County Council had been dropped, and a possible result might be that at a later date the cost of effecting such undertakings might fall on the local authority.

In reply to Mr. FITZGERALD, K.C., WITNESS admitted that the argument urged for bringing the tramways over Westminster and Blackfriars Bridges was to do away with the dead-end termini in busy parts; and it was now proposed to create a dead-end terminus at the Marble Arch. This scheme, however, was only a part of a comprehensive scheme which the Highways Committee of the London County Council had before them. He could not produce the scheme as it was private, and had not been before the County Council.

Cross-examined by counsel for the Paddington Borough Council, WITNESS said they had taken the cost of working, and had arrived at the conclusion that the tramway would be remunerative.

Mr. ROBERTSON, representing local authorities concerned, proceeded to cross-examine witness as to whether the final voice as to what system should be adopted would not lay with the local authorities.

The CHAIRMAN said he could relieve their minds of that, as he did not think the Committee would sanction overhead wires in the heart of London.

Further examined, WITNESS said it was proposed to obtain the necessary electrical energy for working the tramways from the Greenwich generating station. He denied that there had been any loss on the southern system of tramways, if they were taken as a whole.

Mr. ROBERTSON was proposing to question witness as to certain lines, when

Mr. ERSKINE POLLOCK objected to such a course being pursued, and said that Mr. Haward, the Comptroller of the Council, would be called with regard to the financial bearings.

Mr. ROBERTSON said he had four cases where loss was anticipated according to the reports in the agenda paper of the County Council.

The CHAIRMAN said the Committee were going to have an investigation into the financial aspect of the tramway ventures of the L.C.C. Mr. Haward would come and produce his papers, in addition to papers which the Committee were going to ask for.—The Committee again adjourned.

THURSDAY, MAY 3RD.

At the resumed sitting of Thursday, after local evidence had been called in favour of the trams from the Marble Arch to Cricklewood,

Capt. HEMPHILL, chairman of the Highways Committee of the L.C.C., was called, and said that the tramways in question had been under the consideration of the L.C.C. for a considerable time, but owing to the opposition of local authorities that was the first time they could bring the proposals before a committee. His Committee believed it would be both a useful and profitable line. The Middlesex County Council was obviously of the same opinion, and so the two Councils had met together to see how in the interests of the public they could make as serviceable a route as possible. The agreement they had come to would facilitate the passage of traffic, and one of the objects was to induce those living in the congested districts off the Edgware Road to move further out. He certainly thought it a case where local authorities would derive advantage, and that they should contribute to the necessary street widenings.

In reply to Mr. BLENNERHASSET, WITNESS said he doubted if the tramways in the Paddington district would be made unless the Paddington Borough Council contributed to the street widening. He believed that the Paddington Borough Council would on reconsideration see that the inhabitants desired the tramway, and as a result they would contribute.

By Mr. MACONOCHIE: They ought to have at least 200 miles of additional tramway in London, and the tramway in question was only part of a large scheme they hoped to carry out in time. He did not know which would be the next part of the scheme undertaken.

Mr. H. E. HAWARD, Comptroller of the London County Council, attended at the request of the Committee, and gave evidence regarding the whole financial position of the Council's tramways up to March 31st of this year, with estimates for the current year. Witness said that the Council took over the system of the London Tramways Co. on January 1st, 1889. On April 1st, 1902, they took over the undertaking of the South-East Metropolitan Co., and in November of the same year, they took over the South London Tramway Co.'s undertaking. On these two undertakings, after charging £7,880 for interest and sinking fund, there was for 1901-3, a deficiency of about £2,700, which was included in the table he handed in, showing the financial results in each year of the southern system since 1899, viz.:—

TABLE I.—LONDON COUNTY COUNCIL TRAMWAYS (SOUTHERN SYSTEM).

Table showing the Financial Results in each Year since 1899.

Year.	Surplus on working.			Charges against surplus.					Balance.
	Horse.	Electric.	Total.	Interest and repayment of debt.	Income-tax.	Provision for future renewals.	Liquidation of costs of temporary generating stations.	Total.	
Jan. 1st to March 31st, 1899	£14,958	—	£14,958	£11,885	—	—	—	£11,885	£3,073 surplus.
1899-1900	97,950	—	97,950	41,217	£558	£4,391	—	46,166	£51,774 „
1900-1901	75,680	—	75,680	48,380	5,975	7,000	—	61,355	£14,325 „
1901-1902	65,234	—	65,234	43,448	3,724	9,000	—	56,172	£9,062 „
1902-1903	62,455	—	62,455	49,870	3,836	11,000	—	64,706	£2,251 deficiency.
1903-1904	15,936	£81,413	97,349	100,537	2,200	—	2,896	105,633	£8,284 „
1904-1905	—529	207,309	206,780	136,954	3,261	35,000	24,510	199,725	£7,055 surplus.
1905-1906, partly estimated	1,000	217,000	218,000	166,000	4,000	35,000	9,000	214,000	£4,000 „
1906-1907, estimated ...	—6,000	304,000	298,000	*168,000	10,000	62,500	6,400	246,900	£51,100 „

* Excluding debt charges for power station which are included in the total cost of power and brought into account before arriving at the surplus on working.

The deficiency for the years 1902-3 was due entirely to the loss of receipts of nearly £18,000, owing to the dislocation of traffic during the reconstruction of the Tooting line for electric traction and the cessation of the Council's omnibus service over the bridges. The deficiency in 1903-4 was due to the same cause. During the process of reconstruction the tramway undertaking suffered very materially not only from the loss of receipts, but also owing to the much heavier working charges arising from the necessity of testing the electrical working to bring it up to a sufficient state of perfection. The accounts for 1904-5, which showed a surplus of £206,780 on the working, were in excess of the estimates for the year by £36,000. The following were the receipts and expenses in connection with the lines worked by electric traction for the past three years:—

TABLE II.

Year.	Miles run.	Receipts per mile.			Expenses per mile.	Surplus on working per mile.
		Traffic.	Sundry.	Total.		
1903-4 ...	4,469,576	11·94d.	·22d.	12·16d.	7·76d.	4·40d.
1904-5 ...	10,931,396	11·76d.	·28d.	12·04d.	7·49d.	4·55d.
1905-6 ...	12,164,292	12·08d.	·25d.	12·33d.	*7·97d.	*4·36d.

* Approximate.

The electric lines had so far been worked by power obtained from temporary generating stations at a much higher cost per unit than would be the case when the power was supplied from the Council's own generating station at Greenwich. The results given

in Table I for 1906-7 were of course estimated, and showed a surplus of £51,100. The figures for 1905-6 related to the working of 53 road-miles of tramways, of which 51½ miles had been taken over from time to time from the tramway companies, and 1½ miles had been constructed for electrical traction by the Council. Of the 51½ miles, 29½ miles had been reconstructed for electric traction. Witness handed in a table giving particulars on two routes of the results from horse traction and electric traction. The average increases in the receipts per mile were 1·49d. and 1·57d. respectively in favour of electric traction. Witness proceeded to explain the following table, showing the comparison of financial results between the Council's southern tramways, the London United Tramways and the Central London Railway Co.:—

Table III.

—	L.C.C. southern tramways. Year to Mar. 31st, 1905.	London United Tramways Co. Year to Dec. 31st, 1904.	Central London Railway Co. Year to June 30th, 1905.
Capital expended ...	£2,623,692	£2,905,095	£3,888,285
Profit on working ...	£203,519	£120,874	£170,545
Percentage of profit to capital expended	7·6 %	4·1 %	4·4 %
Amount of reserve and depreciation funds	£66,600	£5,000	£62,500
Suspense accounts included in assets	£24,510	—	*£92,296
No. of passengers carried	164,818,560	48,126,727	44,943,585
Average fare per passenger	·97d.	1·47d. approximate.	1·86d.

* Parliamentary expenses .. .. .. £23,296.
Locomotive suspense .. .. £69,000.

The average of 1·86d. per mile on the "2d. tube" was due to workmen's fares. He did not hold the London United Tramways Co. and the Central London Railway Co. up as model undertakings, but simply gave the figures to show that the London C.C. tramways compared most favourably with them. As from April 1st, 1906, the Council began to work the tramways on the north side of the Thames extending over about 50-route miles. The Council had previously purchased the tramways and leased them to the North Metropolitan Tramway Co. for a period terminating in 1910. The company had worked the lines by horse traction, and it was with the view to expedite the reconstruction for electric traction that the Council purchased the remainder of the lease. They had now made arrangements for the reconstruction of the first section of the lines, which would be about one-fourth of the whole. During the period of reconstruction the Council did not expect these lines to show a surplus. They anticipated that there would be deficiencies, which, however, would be met out of the surplus now being realised on the southern system, so that there would be no need to have recourse to the rates even during the period of transition. As a matter of fact, the Finance Committee and the Highways Committee had had under consideration the precise moment when they should electrify the northern lines, the idea being to see the south on its legs before proceeding with the north. There was a further desire to have full use for the Greenwich generating station as soon as it was opened. It was anticipated that in electrifying the northern lines and in connection therewith of constructing some 10 miles single track of extension already authorised, the Council would have to incur a capital outlay of about £3,000,000 to £4,000,000. When the work of reconstruction was finished it was estimated that there would be an annual surplus of over £60,000, after providing £87,000 a year for renewals, reserve fund, and paying interest and sinking fund on the total debt incurred for the Northern system, including the original purchase. That estimate was made two years ago, and was based on 1s. a mile for receipts, and 7d. a mile for working. The subway, which was the only portion of the Northern lines electrified, was working very well, but the line itself would not pay, owing to the heavy capital cost of construction. As soon, however, as it was possible to extend the subway to the Embankment, and to run a through service of cars, the line would show good results. Witness then put in Table IV, showing the financial results of the Council's tramways from April 1st, 1894, to March 31st, 1906. Witness pointed out that £293,592 had been carried to the relief of rates.

The Chairman pointed out that during the past three years nothing had been carried to the relief of rates.

Witness said that was so, but the Council were building up a large reserve. The reserve fund was invested in London County Council stock. The next table (V) showed the total capital expended by the L.C.C. on tramways, the amount repaid, and the amount of debt outstanding on March 31st, 1906:—

Table V.

Total capital expended—		
Southern system	£3,141,319	
Northern „	1,095,469	
General (including power supply) ...	581,246	
		£4,818,034
Total capital repaid—		
Southern system	£455,119	
Northern „	134,876	
General	17,236	
		£607,231
Outstanding debt, March 31st, 1906—		
Southern system	£2,686,200	
Northern „	960,593	
General	564,010	
		£4,210,803

The capita expenditure was repayable partly in 60 years, and partly in 38 years, and was repayable on the instalment system, which was more economical than the annuity system. Of the £607,231 repaid, £165,000 came from the sale of horses. In addition to the outstanding debt, the Council was also committed to the following further capital expenditure in respect of tramways:—Reconstruction of northern system, £3,000,000 to £4,000,000; completion of the reconstruction of the southern system, £1,000,000; completion of the Greenwich power station, £500,000; new lines authorised, some of which were in course of construction, £1,100,000. This gave a total of 5½ or 6½ million pounds, and the Committee might take it roughly that the total capital expended, or in prospect of being expended, amounted to £11,000,000, of which they had repaid half a million.

Mr. Barnard: How many miles of tramway does this money represent?—Witness said he believed it was 121 street miles, mostly double track.

By the Chairman: This £11,000,000 covered the complete electrical equipment of the authorised lines, but it did not include the proposals in the Bill before them. The conduit system was expensive, and cost from £35,000 to £40,000 per mile of single line.

Mr. Barnard said that with 121 miles of tramways, it cost them roughly £1,000,000 to construct 11 miles of tramway.

Mr. Pollock, K.C., said he believed that there were some tramways included in the estimate in addition to the 121 miles, but the figure mentioned by the hon. member was not so much out.

Witness handed in the statement (Table VI), showing the details of the total capital expenditure up to March 31st last.

In answer to Mr. Maconochie, Witness said they expected a considerable addition to their profit by generating their own electricity.

By Mr. Robertson: He did not consider that 1d. per car-mile was a low sum to place away for depreciation. It had to be remembered that the Council were also paying off the debt, and Parliament had not put on any local authority the duty of forming a renewal fund. Still better results were anticipated on the southern system when full advantage could be taken of the Greenwich power station, for in the past they had been paying as much as 2⅜d. per unit, whereas they could obtain it at 1¼d. from

Table IV.—Financial Results of L.C.C. Tramways.

Year.	Balance brought forward.	Year's results. Surplus (+) or deficiency (−). South.	North.	General.	Total.	Total (including balance).	Carried to relief of rates.	Balance carried forward.	Year.
	£	£	£	£	£	£	£	£	
1894-5 ...	—	—	+ 1,121	—	+ 1,121	1,121	—	1,121	1894-5
1895-6 ...	1,121	—	+ 2,659	—	+ 2,659	3,780	—	3,780	1895-6
1896-7 ...	3,780	—	− 2,098	—	− 2,098	1,682	—	1,682	1896-7
1897-8 ...	1,682	—	+ 69,526	—	+ 69,526	71,208	49,000	22,208	1897-8
1898-9 ...	22,208	*5,592	− 14,781	—	− 9,189	13,019	—	13,019	1898-9
1899-1900 ...	13,019	+54,847†	+ 66,315	− 1,915	+119,247	132,266	110,592	21,674	1899-1900
1900-1 ...	21,674	+14,326	+ 40,152	− 6,936	+ 47,542	69,216	69,000	216	1900-1
1901-2 ...	216	+ 9,062	+ 39,156	− 3,252	+ 44,966	45,182	45,000	182	1901-2
1902-3 ...	182	− 2,251	+ 37,794	− 5,856	+ 29,687	29,869	20,000	9,869	1902-3
1903-4 ...	9,869	− 8,283	+ 27,657	−10,678	+ 8,693	18,565	—	18,565	1903-4
1904-5 ...	18,565	+ 7,055	+ 22,836	−18,467	+ 11,424	29,989	—	29,989	1904-5
1905-6‡ ...	29,989	+ 4,000	+ 24,000	−25,000	+ 3,000	32,989	—	33,000	1905-6
Totals ... £		84,348	314,337	−72,104	326,581	—	293,592	—	—

* Proportion of profits of company's working from April 10th, 1897, to December 31st, 1898. † Includes the three months to March 31st, 1899.
‡ Partly estimated.

TABLE VI.—SHOWING TOTAL CAPITAL EXPENDITURE TO MARCH 31ST, 1906.

	Southern system.	Northern system.	General (including power supply).	Total.
HORSE TRACTION:—	£	£	£	£
Purchase of undertakings and incidental charges	1,310,507	806,087	—	2,116,594
Additions	23,814	43,314	—	67,128
ELECTRIC TRACTION:—				
Power supply—				
Power station—				
*Land	—	—	26,450	26,450
Buildings	—	—	162,345	162,345
Pier	—	—	47,882	47,882
Machinery and plant	55,905	—	153,403	209,308
Sub-stations—				
*Land	24,225	28,838	—	53,063
Buildings	67,283	2,538	—	69,821
Machinery and plant	54,075	212	—	54,287
Cables and ducts	104,873	1,060	55,252	161,185
Permanent way	933,630	65,331	—	998,961
Car-sheds, &c.—				
*Land	26,239	7,129	9,227	42,595
Buildings	205,346	1,748	293	207,387
Workshop tools and sundry plant	12,254	—	—	12,254
Cars	261,200	58	—	261,258
Salaries	5,406	647	2,064	8,117
Street widenings (proportion charged to tramways account) ...	41,005	15,000	34,500	90,505
Alterations to bridges	15,557	7,432	38	23,027
Construction of subway under Kingsway	—	116,075	—	116,075
Land acquired for second generating station	—	—	89,792	89,792
	£3,141,319	£1,095,469	£581,246	£4,818,034

* Some buildings are erected wholly or partly on sites purchased from companies as part of horse traction systems. These figures relate only to purchase of additional lands.

their own generating station. In his opinion, the tramway undertaking was financially sound; and even if in the interests of the travelling public the Council decided to open routes from time to time which might not at the outset be entirely self-supporting, there would be a large and growing surplus on the undertaking as a whole to cover the risks incurred.

(*To be continued.*)

London County Council (Electric Supply) Bill.

(*Continued from page* 710.)

TUESDAY, MAY 1ST.

MR. FREEMAN, K.C., continuing his address on Tuesday, May 1st, said that in 1899 a very important inquiry took place before Major Marindin with the idea of determining to what companies and local authorities orders for electric power should be given. At that time a communication was addressed immediately before the sitting of the inquiry, by Sir Henry Calcraft, acting on behalf of the President of the Board of Trade, to Earl Rosebery, who was at that time Chairman of the L.C.C., in which the following words occurred:—"Before deciding on the action to be taken on the applications at present before the Board of Trade they propose to adopt their usual procedure and hold a local inquiry, of which full notice will be given, and at which all those interested can be heard, but they are anxious to take no definite step which may have important bearing on the future policy to be pursued with regard to electric lighting in the metropolis without communicating in the fullest manner with the County Council of London. In this determination they are greatly influenced by the consideration that before long the jurisdiction which the Board of Trade now exercise with regard to electric lighting matters in the metropolis may be transferred to the County Council, and they would therefore be most unwilling to take any action which may hamper that body in dealing with the question in the future." To show the connection of the County Council with that question, the next date he would mention was the year 1898. In that year the Bulk Bills of the Central Electric and the Metropolitan Companies were introduced; and a conference of local authorities took place in the June of that year, at which a resolution was passed to the effect that it was desirable that the L.C.C. should be in a position to undertake the supply of electricity. In that year, too, the Council were in communication with the Board of Trade as to introducing a measure for purchasing bulk supply stations and also for supply. In 1903 the Board of Trade intimated that they would be prepared to introduce such a Bill, and asked the County Council to hold its hand. In that year and in the following year a Bill was introduced, but was dropped. Counsel then went into the history of the proceedings before the Committee last year, and coming again to the present Bill pointed out that the Council owned, and would within a very short period work, the whole of the tramways of London, which meant 300 miles of single line. Then again the Council had the same interests as the boroughs, and would be working in harmony with them. As to the capacity of the Council's existing electric plant, he said that in June of this year it would have a capacity of 10,500 KW. On a basis of 40 per cent. load factor, that would mean an output during the following 12 months of practically 37,000,000 units, which, by 1915, would have risen to nearly 90,000,000 units. The total amount now being sold by local authorities and companies in the County of London was 131,000,000. Therefore the Committee would see at once, that the proportion of 37 now, and of 89 in 1915, to the total sale of what was sold for ordinary purposes by local authorities and companies, the tramway load was an enormously advantageous factor, and gave a fine nucleus on which to carry on the business successfully and commercially. That being the position of things, the County Council, finding no Government Bill was going to be introduced, took the matter into consideration and resolved to proceed with this Bill. Learned Counsel then proceeded to a consideration of the commercial aspects of the scheme. It was proposed, he said, to spend £2,370,000 on providing a generating station at Battersea, and on the transmission mains. Those transmission mains were proposed to serve 21 centres in the metropolis, and 8 centres in the districts round about outside. The first half of the Battersea station would be ready in 1909, and until then the Greenwich plant, which was not required for the tramways, would be used for supplying in bulk. In 1908 they would have released at Greenwich, for bulk supply, 10,000 KW.; in 1909, from Greenwich and from the part of Battersea, they would have 36,000 KW.; in 1911, with a larger supply from Battersea, 50,000 KW., and in 1913 from Battersea, leaving Greenwich entirely for the tramways, they would have 60,000 KW. The next question was what the probability was of that supply being taken, and it was estimated that in 1911 there would be an increase in the demand for units of upwards of 390,000,000, and if only one-third of that was taken from the L.C.C., without assuming in a single case the local authority taking its supply from the Council, then the amount the Council had set free for delivering would be required and would be absorbed. As to the charges to be made, the Council proposed £3 12s. per KW., while the charge, according to the actual kilowatts used, would be ·2d. per unit. In conclusion, Mr. Freeman said that he should ask the Committee, when they had heard the evidence, to say first of all that the scheme was required; secondly, that it could be carried out with great advantage to the people who wanted electricity; thirdly, that it was far better that it should be done by a municipality than that any company should have a monopoly; and lastly, that it could be done in such a way as would not entail any financial loss on the ratepayers.

Mr. T. MCKINNON WOOD, M.P., Chairman of the Parliamentary Committee of the L.C.C., was then called, and bore out the statements of Counsel's opening speech. He said that ever since the year 1889, the Council had been closely connected with this question of electrical supply to London, and since the year 1898 the question of the bulk supply of electricity had been before the Council. Witness read the resolution passed at the conference of borough councils affirming the principle of the Council affording a supply of electricity in bulk. With a view of giving effect to those resolutions, the Council in 1902 introduced an electric supply Bill, which dealt with the question of purchase, and also would have given powers with regard to supply in bulk. A similar Bill was introduced in 1903. The Bill introduced by the Government in 1903 prevented the Council doing anything, as when the Board of Trade was dealing with the matter the County Council could not touch it. The Government Bill was again introduced in 1904, and was passed by the House of Lords, but withdrawn before the second reading in the House of Commons. Again, in 1905, the Bill was introduced, but again it failed to reach a second reading. It came to this, that during the period from 1902 to 1905, whilst the Government Bill was before Parliament, the Council refrained from promoting any Bill at all.

Sir FRANCIS LOWE (a member of the Committee): They were satisfied with the Government Bill, were they?

WITNESS: No; but it was hopeless for us to introduce legislation when the Government was dealing with the matter. The Council,

witness continued, had received a direct intimation that the proper course was to deal with the matter by a Government Bill, and they had accordingly held their hands. As to the present scheme, witness considered it practicable. A large number of local authorities were now already engaged in the business of distributing, and it was undesirable that those authorities should be called upon to place themselves in the hands of a company for the purposes of a bulk supply. That would complicate the question of purchase, which was already sufficiently complicated, and he thought that the matter concerned the companies themselves. When the time of purchase came, the situation would be a ridiculous one, with stations in one place and mains in another. He believed that the end of any scheme for the bulk of electricity to London by the companies would be that they would have to be bought up at monopoly price.

WITNESS was then cross-examined by Mr. BALFOUR BROWNE, K.C., on behalf of the companies supplying electrical energy in the County of London. He said, in reply to learned counsel's questions, that the Council certainly did not wish to let any charge fall upon the rates. He was not prepared to say that if the scheme competed with authorised authorities it ought to be altered; it was bound to compete with companies that had bulk powers.

WEDNESDAY, MAY 2ND.

Mr. MCKINNON WOOD was further examined by Mr. BALFOUR BROWNE, and stated in reply to learned counsel's question that the area scheduled in the Bill totalled about 38,789 miles. The larger part of it was outside London. The Council, he admitted, would be in the same position as a statutory company, but he could not say that the question of purchase by the local authorities in the area outside London would be prejudiced by the Council's scheme. He knew that the point had been urged last year by the Council in opposing the Administrative County of London scheme.

Mr. BALFOUR BROWNE then questioned witness as to the debate which took place in the Council on the matter, and read a report of some part of the proceedings. Witness did not think the report was correct.

The CHAIRMAN remarked that the Committee had the conclusion of the Council as a body.

In reply to a further question, Mr. MCKINNON WOOD said that it was not proposed to spend a large amount of capital at once, but they would develop the undertaking as the demand grew. If they could not supply cheaper than the existing undertakers no one would take a supply. Should there be a loss it would fall on the rates in London, and not on those outside. The clause giving the Council power to go to the B. of T. to reduce the price charged by the authorised distributor had been inserted for the benefit of the consumer. It was not intended to force a distributor to take power from the Council.

Witness was then cross-examined by Sir RALPH LITTLER, K.C., for the Corporation of London. He admitted that there were no large manufacturers in the City, but he did not think that the City could avoid its responsibility of being part of London.

By the Hon. J. D. FITZGERALD, K.C. (for the Administrative County of London Co.): He did not know of a power company which had been started as a permissive undertaking and had proved a success. Of course, he was aware that electric plant, such as was in use a few years ago, had become obsolete.

By Mr. BLENNERHASSETT, K.C.: He knew that the Borough Councils who voted on behalf of the Council's scheme at the Conference, represented less than half of the rateable value of London, but those who voted represented the industrial areas.

WITNESS having been examined by counsel representing various local authorities, the Committee adjourned.

THURSDAY, MAY 3RD.

Mr. MCKINNON WOOD was re-examined by Mr. LEWIS COWARD, K.C. Witness thought that the poorer parts of London were very interested in the question of electricity supply, because they were largely the manufacturing districts. With regard to the statement that there might be undue preference in supplying one company to the disadvantage of another company, he said that there could be nothing of the kind. There was not the slightest foundation for the suggestion that the Council was not *bonâ fide*.

Replying to Mr. RUTHERFORD, WITNESS said that the Council considered that the local authorities should have the right of purchasing the companies' undertakings in 40 years, but the Council itself did not propose to purchase the undertakings of the local authorities. With regard to the revision of prices, he did not think it would be practicable for the Councils outside the area to have a similar power in regard to the prices charged by the Council. The Council in working out the scheme had given consideration to the question of smoke, and his opinion was that the scheme would help very materially to reduce the amount of smoke in London. Besides that, the undertaking would be under the control of the Council, which was the authority which dealt with smoke nuisances.

In reply to Sir FRANCIS LOWE: It was very difficult to say where the interests of London stopped. London and the immediate outskirts would undoubtedly be the most profitable.

Mr. J. H. RIDER, electrical engineer to the London County Council, was then called. He said that he designed the whole of the engineering work at the Greenwich generating station, which was the largest municipal station in the world. Since he had been in London, for the last five years, he had had under consideration the question of bulk supply, and was in favour of having large stations, as they were more economical. Stations must be situated near a good supply of water for condensing purposes, and should be in a position to obtain a supply of water-borne coal. He considered that the size of the generating units depended upon the size of the station. Turbo-generators were better than reciprocating engines. Load factor had a considerable bearing upon price. It depended upon the coal consumed, the labour which had to be kept, and other considerations. He thought it would be quite sufficient to give a supply to the authorised undertakers, without going direct to the small consumers. The largest consumers would, of course, take a supply direct, as the Bill proposed. Much of the success of such a scheme as that depended upon the size of the area, and the larger that was the greater the chance of making the scheme remunerative and of getting a diversity of load. There were many advantages in keeping a traction and a bulk load together. The two benefited each other. The Greenwich station would be used first of all, and then the Battersea station would be built and used for the bulk supply. There would be 25 sub-stations, and all would primarily be placed so as to be convenient for the tramways. At the present time nine of these sub-stations were in existence. Witness put in tables of estimates of expenditure on capital and revenue accounts. From these it appeared that the net capital expenditure proposed was £2,370,187. The cost of the land for the Battersea generating station was £120,000, of which the credit portion to be taken by the Tramways Department was £60,000. The buildings for the station would cost some £384,000; the turbo-generators with condensers, £360,000; the boilers, economisers and stokers, £200,000; switchgear and general accessories, £52,000; piping and pumps, £60,000; the coal handling plant, £20,000; and the river work, including pier, &c., £64,000; a total of £1,200,000. The transmission system would cost altogether £1,065,187, while the interest on capital outlay during construction would be £105,000. This would bring the total expenditure on the works included in the Bill up to £2,370,187. This expenditure would be spread over a number of years, as the station would be built in three stages as demand required, the complete station, with a capacity of 80,000 KW., being estimated to cost £15 per KW. The normal capacity of the station would be 80,000 KW., and the overload capacity 120,000 KW. Witness submitted also a table showing the proposed charges, and explained that the energy would be at 6,500 volts, three-phase, 25 cycles, delivered to the bulk supply customers within the area of supply at £3 12s. per annum per KW. of maximum demand, plus 0·2d. per unit actually delivered. The table showed that up to 2·96 hours per day, with a load factor of 12·3 per cent., the price per unit would be 1d.; at 3·50 hours, 14·5 load factor, it would be ⅞d.; at 4·38 hours, 18·2 load factor, it would be ¾d.; at 5·57 hours, 23·2 load factor, ⅝d.; at 7·89 hours, 32·9 load factor, ½d.; and at 13·5 hours, 56·2 load factor, ⅜d. These charges were based upon an estimated diversity in the maximum demands of the various bulk supply customers of 80 per cent., so that the net income would be £4 10s. per KW. of maximum demand upon the generating station, plus 0·2d. per unit. Witness then went at some length into an explanation of the cost of generation at the Greenwich station, which he said totalled £144,954, or 0·4449d. per unit, this including capital charges, management and office, and rates and taxes. The estimated cost of transmission was 0·1012d. Coming to a consideration of the estimated working expenses of the two stations, witness put in a table showing that these were placed at £316,161, or 0·6243d. per unit for the Battersea station half completed and the Greenwich station completed, the total number of units per annum from the completed station and the half-completed station being 121,545,000, the estimated net revenue from the half-completed station and the completed station being £158,016. Witness submitted other tables showing the estimates at varying outputs and at varying stages in the completion of the Battersea station. The following table shows the estimated working expenses with both stations completed:—

			Totals.	Per unit.
(1) GENERATION AT BATTERSEA.—				
Coal—205,312 tons at 9s. 6d. per ton (3·5 lb. per unit on average)	£97,523			
Water, oil, waste and sundries	4,500			
Labour	11,600			
Repairs and maintenance	16,290			
(0·2372d.)		£129,913		
GENERATION AT GREENWICH.—				
Coal—99,720 tons at 9s. 6d. per ton (4·0 lb. per unit on average)	£47,367			
Water, oil, waste and sundries	3,500			
Labour	10,000			
Repairs and maintenance	7,900			
(0·2955d.)		68,767	£198,680	0·2546d.
(2) CAPITAL CHARGES.—				
Battersea—Interest and sinking fund ..		69,431		
Greenwich—Interest and sinking fund..		49,028		
Transmission system, interest and sinking fund		84,388		
		£10,300	202,847	0·2600d.
(3) MANAGEMENT AND OFFICE.—			10,300	0·0132d.
(4) TRANSMISSION.—				
Labour		£13,500		
General stores		2,000		
Travelling expenses		1,000		
			16,500	0·0211d.
(5) RENTS, RATES AND TAXES.—				
Rates and taxes		£37,000		
Rents of supply centres		760		
			37,760	0·0484d.
Total			£466,087	0·5973d.

Battersea station completed with 8 × 10,000 KW. machines = 30,000 KW. normal, or 120,000 KW. overload capacity.

Assuming 60,000 KW. maximum load at one time, and load factor of 25 per cent. output = 131,400,000 units per annum.

Greenwich station completed with 4 × 3,500 KW., and 4 × 5,000-KW. machines = 34,000 KW. normal capacity.

Assuming 25,500 KW. maximum load at one time, and load factor of 25 per cent. = output = 55,845,000 units per annum.

Total combined output = 187,245,000 units per annum.

TUESDAY, MAY 8TH.

Mr. RIDER was cross-examined by Mr. RALPH NEVILLE, K.C., for the companies. He said that he had adopted 6,600 volts primarily, because that was the voltage existing now at Greenwich. It also gave an economical supply over an area of six miles from each generating station. That distance from either Battersea or Greenwich included all the authorised distributors. Beyond those he did not expect to have to give a supply at first. No doubt later on a third generating station would have to be erected. An economical supply was, he admitted, one of 1 mile per 1,000 volts. Perhaps a higher pressure might have given a cheaper supply to a further distance. On that basis a station might be taken out of London. It was possible to transform his 6,600 volts, 25 cycles current to the frequency of any distributor.

Mr. NEVILLE said that he should call witnesses to show that that would not be a profitable business transaction.

By Mr. LLOYD, K.C. (for the Administrative Co.): He had not specially considered the question of the suburban railways of London taking a supply of current. Of course, it would be a good addition to the load, but he could not say what it would amount to. Witness admitted that it had taken the Council from 1901 until this year to complete the first half of its Greenwich station.

Mr. LLOYD: That's not a very happy sample.

WITNESS could not say that he would have adopted a station of the Greenwich type for a power supply.

Mr. LLOYD: But having got that power house on your hands, you must take things as they are.

Cross-examined on the question of the carrying capacity of a 3·5 cable, WITNESS said that he considered such a cable capable of carrying 3,000 KW. up to any distance with a loss of not exceeding 5 per cent. At the end of the 7¾ miles it would have dropped to 2,975 KW.

(To be continued.)

West Yorkshire Tramways Bill.

ON Thursday last week a Select Committee of the House of Lords, presided over by the Earl of Lauderdale, commenced the consideration of the West Yorkshire Tramways Bill, by which it is sought to incorporate a company with a capital of £120,000 to construct tramways in the Borough of Huddersfield, the Borough of Brighouse, and the districts of Elland, Greetland, Foxley, Clifton, &c., and to transfer to the company certain powers for the construction of tramways now held by the Huddersfield Corporation.

Mr. H. LLOYD, K.C., opened the Bill for the promoters, and said that the gentlemen interested were well in a position to carry out what was proposed in the Bill. The Huddersfield Corporation had already constructed a certain number of tramways, and were authorised in 1902 to construct others, but they had not yet seen their way to construct the line from the south to Brighouse. The Corporation recognised the desirability of carrying out this proposal, and supported the Bill in that respect. The promoters also asked for power to construct a tramway to Greetland, and to form a junction with the tramways of the Halifax Corporation. Further, they asked for running powers over the tramways of the Huddersfield and Halifax Corporations.

Mr. FREEMAN, K.C., appeared for the West Riding County Council, who asked that clauses should be inserted for the proper widening of certain roads.

After hearing evidence, the CHAIRMAN said that unless the promoters could come to an arrangement with the County Council it would be no good going on with the Bill. The proceedings were accordingly adjourned.

On Friday Mr. LLOYD asked for a further adjournment until Monday to allow of an arrangement being come to, and this was granted.

On Monday Mr. FREEMAN, K.C., asked that in the clause in the Bill which provided for the protection of the road authorities in the matter of the paving and maintenance of roads, the West Riding County Council should be inserted as the authority.

Mr. LLOYD, K.C., for the promoters, objected to this. He pointed out that, by the general law, the local authorities were the road authorities. The promoters had agreed with the road authorities that where a road was paved they should pave the tramway portion, and should do the same where the road was not paved. The County Council apparently wanted to override both the local authorities and the company, and if what was proposed was agreed, the promoters might be called upon by the local authorities and the County Council to do different things.

Mr. FREEMAN said they were all main roads, and the County Council had to pay the bill for repairs. Unless the County Council was put into the clause, they would have no power whatever. At the time that the Tramways Act was passed it was not contemplated that the County Council would be in the position of paymaster.

Mr. LLOYD pointed out that if the suggestion was adopted there would be for the purpose of this Bill, and this Bill only, two local authorities who would be masters of the company, whereas the general law now had prescribed one authority. He submitted that the Bill should be left as it was, leaving the local authority to call upon the company to carry out what works were necessary. At present the local authority would be able to take the company to the Board of Trade, and he did not object to that, but he did object to two authorities having such power.

After consulting in private, the Committee decided to leave the clause as it stood in the Bill.

The Committee proceeded to deal with the clauses relating to running powers, and it was stated that the company and the Corporations of Halifax and Huddersfield had agreed to an arrangement providing for through communication between the two towns being carried out either by the company or by either of the Corporations. The only question was that the powers agreed upon were not provided for in the Parliamentary notices, and if the Lord Chairman of Committees declined to allow the Bill to proceed, then the clause should be dropped.

Buenos Ayres Grand National Tramways Co. Bill.

ON Tuesday and Wednesday last week a Select Committee of the House of Lords considered this Bill, under which it is proposed to deal with the capital of the company consequent on the electrification of the lines.

Mr. RALPH NEVILLE, K.C., in opening the case for the promoters, said that the company had now a capital of £645,000 divided as follows: "A" preference shares £220,000; "B" preference shares £125,000; second preference shares £50,000; ordinary shares £250,000. By the Bill before the Committee, it was proposed to increase the capital to £1,075,000, and so wipe out the arrears of dividend. The undertaking had so far been worked by horse traction, and had not been remunerative, and at present the total arrears on the preference shares amounted to £354,000, while in addition there stood to the debit of profit and loss account a sum of £129,855. Thus it would be seen that unless some arrangement was made there would be an enormous sum to be paid off when electrification was complete before any dividend could be paid. In 1888 the Grand National Co. made an agreement with the Nueva Tramway Co. by which the former company worked the lines of the latter, so that the Grand Tramway Co. was in possession of a system of about 80 miles of tramway. They had also a concession to construct a further 12 miles, and were applying for a concession for another 13 miles, which there was little doubt would be granted so that in the aggregate the company would have the control of 105 miles of tramway. There were eight systems of tramway at work in the district, three of which had been electrified, and it was the success of the electrified tramways which induced the Grand National to undertake the electrification of their lines. This electrification was proceeding at the present time, and so far the company had converted 30 or 35 miles of tramway, and so far as could be judged by the partial experiment, the success of other lines had been repeated in the present case. To show what could be done, he might point out that the Belgrano Co. had receipts of £68,800 in the last year they worked their tramways by horse traction, while in the first year of their complete electrical working the gross receipts were £147,212. The net receipts under the old system were £19,100, while in 1901, under the electrical system, they were £59,900. Then the gross receipts of the Anglo-Argentine Tramway Co. in 1901 under the horse system were £253,866, and in 1904 under the electrical system they were £418,093. The net receipts of that company in 1901 were £67,294, and in 1904, £190,565. In view of the state of the company's finances, the board called the chief preference shareholders together, and the scheme now brought forward was really the outcome of the suggestions made at that meeting. The only opposition came from the petitioners, Messrs. Elliott and Perks, who were holders of preference shares. What was now proposed was that the existing rate of interest on the "A" and "B" and second preference shares should be reduced from 7 per cent. to 5 per cent., but that for each holding of £100 preference shares, £120 preference shares should be given. Then to meet the arrears, ordinary shares would be issued to the "A" and "B" preference shareholders; the "A" shareholders getting somewhat more than the "B," while the second preference shareholders would waive their arrears in consideration of their being placed on the same footing as the other two classes of preference shareholders. It was further proposed that the £129,000 loss should be written off. The value of the concern when the tramways were electrified, would be enormously increased, and the wiping off of the £129,000 loss would enable dividends to be paid to the shareholders directly they were earned. It was fully anticipated that they would be able to pay the whole of the preference dividends, and also about 3½ per cent. on the ordinary shares at first when the line was completely electrified. The result of the scheme was to raise the capital from £625,000 to £1,075,000.

Evidence having been called, the Committee found the preamble of the Bill proved.

County Councils and Electric Lighting and Power Orders.—At a meeting of the Executive Council of the County Councils' Association, held at the Westminster Guildhall on Wednesday last week, it was reported that on the previous day a deputation from the Association waited on the Board of Trade to ask the Board to insert in all Electric Power and Lighting Acts and provisional orders certain clauses for the protection of County Councils in respect of bridges and roads. The deputation was received by Mr. Lloyd-George (President of the Board of Trade), Mr. Hudson Kearley, M.P. (Parliamentary Secretary), and Mr. Pelham. Mr. Lloyd-George said that with regard to bridges, he sympathised with the County Councils. He was advised that, as the law stood at present, he could not introduce into provisional orders words which would carry out the purport of the desired clauses. Whether it could be done by the confirming Bill was another matter. If it could be done without infringing the law he was in favour of doing it, and if not he would consider the possibility of introducing a Bill for the purpose.

Crediton Lighting and Power.—The Lord Chairman of Committees of the House of Lords reports that all opposition has been with-

drawn to the above Bill, which seeks to confer powers on the Crediton Lighting Co., which is at present supplying gas, to supply electrical energy in the district.

Bury Corporation Bill.—The Earl of Lauderdale's Select Committee of the House of Lords on Friday considered the Bill promoted by the Bury Corporation which, amongst other matters, provides for the construction of six sections of tramway of a total length of about three miles, and authorises the Corporation to enter into agreements with local authorities as to the purchase, sale, lease and working of tramways. The estimates in the Bill include £54,000 for the construction of tramways, £12,500 for electrical equipment, and £45,000 for the extension of the electricity works. The Committee found the preamble of the Bill proved, but passed the tramway proposals on the condition that certain widenings of thoroughfares should take place.

A Canal Boards Bill.—The *Times* says that the Parliamentary Committee of the Mansion House Association on Railway and Canal Traffic is to introduce in Parliament a Bill to provide for the constitution of a Central Canals Board for the purpose of obtaining provisional orders authorising the Board to take over, improve, and manage certain canals which form a chain of navigation between the principal ports in England, and to acquire other canals.

St. Pancras Electricity Bill.—This Bill came before the Unopposed Bill Committee of the House of Commons, and the preamble was declared proved. The Chairman, in his report, stated that the Bill gave no specific borrowing powers. The Committee decided to insert a provision in the Bill prohibiting the generation of electricity upon certain of the lands referred to in the Bills.

PROCEEDINGS OF INSTITUTIONS.

Economic Considerations in the Employment of Storage Batteries.

By J. R. Salter, M.I.E.E.

(*Abstract of Paper read before the* Institution of Electrical Engineers *at Manchester, March 13th*, 1906.)

It seems to the author that the record of utility established by the battery in earlier days, and the production of the reversible booster, have led engineers to overlook somewhat the economic considerations which should guide them in adopting any particular system of generation or supply.

The considerations which influenced the adoption of batteries in the early days have become to a very large extent modified, and the line of inquiry in this paper is in the direction of comparison between the advantages which the employment of batteries gives under these altered conditions, and the cost at which those advantages are obtained.

Broadly speaking, four general advantages are claimed for the installation of batteries, viz.:—

1. Ability to shut down.
2. Improvement in load factor.
3. Saving in copper.
4. Constancy of pressure at the generating station.

In the attempts which have been made to prove the advantages which are obtained from its use, it has been usual to compare the cost of the battery with that of steam raising plant. Such a comparison is not, to the author's mind, a valid one, and is to be deprecated. It is generally stated that the cost per kilowatt of a battery is equivalent to the cost of steam and electrical plant, based upon the assumption that the battery is discharged at a three-hour rate. It would be quite as reasonable for the advocates of batteries to assume a one-minute rate of discharge, and to show how infinitely cheaper the battery is in capital cost than steam and electrical plant; or, on the other hand, to assume a yearly rate of discharge and to show how infinitely more expensive it is to install a battery than to install generating plant of corresponding capacity. The comparison, therefore, whatever rate of discharge is assumed for the battery, is obviously incorrect.

The author submits, therefore, that the battery cannot be regarded as a part of the generating plant, but only as a transforming device possessing certain storage ability.

It may, however, be contended that the ability of the battery to store energy, which may be utilised when required, is, at any rate, a sufficient justification for regarding it as generating plant of a capacity equal to the difference between the maximum load which the plant is capable of supplying, and the maximum output which the station is called upon to supply, but I venture to think that this claim cannot be substantiated. If it be conceded that the capacity of a generating plant is its capacity at its maximum efficiency, and that such plant can be designed with 100 per cent. overloading capacity for short periods (but of course with lower efficiency) then there is no doubt that any reasonable sized battery, such as one would install in any particular system, could not be regarded as possessing the modified advantage of part of the generating plant. It is clear, therefore, that the capital cost of the battery cannot even be justified on the ground that it is an addition to the generating plant.

In modern practice there is, as is well known, little or no time in which to shut down a station supplying an electric tramway system. The tramway load is generally required for twenty hours in the day, and it is practically impossible to run such a station with two shifts. The third shift, being essential, there is no reason why it should not be fully utilised. It is claimed that the battery is a great source of security in the case of a breakdown in the generating plant, but, is this really so? To be of any great utility for such a purpose, the capacity of the battery would have to be so great, that the capital cost entailed would not be justified. It will, of course, be appreciated that the author's remarks in connection with this section apply to traction and power schemes. In small lighting stations they have an output, the greater part of which is supplied at such times as to enable the battery to take care of the load for the remaining part of the day, thus saving a shift.

The next and probably the most important advantage which is claimed for the battery is the improvement which it gives in the load factor. The question at once arises to what the term "load factor" is intended to convey.

Some improvement in the load factor is due to the fact that with batteries the generating plant in a given time has not only to supply the useful units in a supply, but has also to supply the units which are lost in the battery; the cost of fuel per unit generated is bound to be less, owing to the greater number of units generated, but it will be apparent that the cost per unit usefully supplied will not be so largely affected. That the loss in batteries is considerable, there will, the author thinks, be no dispute. If in tramway and power stations the capacity of the steam generators is assumed (as the author thinks it should be) at its rated capacity, and the overloading capacity is regarded as equivalent to the battery, then the load factor and the annual steam consumption should not exceed the load factor and steam consumption of the sets which the advocates of batteries assume for their purpose to be installed for a given set of conditions.

The third advantage claimed is the saving in feeders; to obtain this advantage, the battery should be placed in sub-stations at distant points. In this way the current supplied to a distant point from the generating station instead of fluctuating would be more or less constant, and it would be possible to utilise feeders of smaller sectional area, only carrying the average current supply instead of the maximum. The installation of batteries at sub-stations or feeding points to effect a saving in the cost of feeders does not affect the load factor at the power station, as in a scheme of moderate size, the fluctuations or the maximum requirements at the various points do not occur simultaneously. The only saving, so far as the feeders are concerned, by the installation of batteries in sub-stations is the saving in copper. The same expense for insulation, covering, for laying and for opening and making good of roadways is involved whether the batteries are installed at the sub-station or not. That a saving in copper alone, by the installation of batteries at sub-stations of a sufficient capacity to enable feeders of smaller section to be employed, is not more than balanced by the cost of the batteries themselves it is difficult to imagine. Such an arrangement further involves a continual cost by reason of the greater average loss in the feeders and by reason of the loss in the batteries.

The other main advantage claimed for the battery is the constancy of pressure at the generating station, or the feeding point; but the author contends that there is no special advantage in constancy of pressure at any one part of the system, if the pressure is fluctuating over the other parts with a tramway supply, it is surely better that the pressure should rise with the load, and so enable the speed to be maintained.

After, therefore, analysing in a general way the advantages which are claimed for the utilisation of batteries, it would appear that the only real advantage which exists is an improvement in the load-factor, which only slightly affects the cost of production per unit, and may not necessarily mean an actual reduction in the total costs for giving a definite supply. Upon general grounds, therefore, the author is led to the conclusion that in moderate sized stations the advantages to be obtained from the use of batteries are not justified by the capital charges involved; and it may be well now to give some actual results in connection with two stations in which he is interested.

In the first station, which supplies current to a tramway system operating an average of 28 cars per day, and which in addition supplies approximately 1,000,000 units per annum for power purposes and for street lighting, the plant consists of two 500-kw. two-phase alternators, one 500-kw. direct-current generator, and a battery having a capacity of 265 amperes for six hours. In addition to this, there is installed a motor-generator of a capacity of 250 kw. for converting from alternating to direct current. It may here be remarked that the capacity of this station and the size of units are out of proportion to the load which has to be supplied, owing first to the fact that the station was designed to deal with a much larger load than at present exists; and, secondly, to the necessity for the installation of different types of plant to supply a somewhat extended area. It is the practice in this station to run the alternator for the purpose of supplying high-tension current to the sub-station, and for driving the motor-generator as an alternating-current motor; the direct-current side of the motor-generator being in parallel with the battery. In this way, the alternating set is fairly well loaded, and the load is fairly steady. The motor-generator set is also practically fully loaded on the five week days, and comfortably copes with the direct-current load. On Saturdays and Sundays, however, it is found impracticable to deal with the load with the one generating set, either with or without the battery, and on these days the 500-kw. direct-current set is utilised in addition to the alternating-current generator, the sets on these occasions being loaded to about half their capacity. The generating sets have in each case an over-loading capacity of 50 per cent., and the average steam consumption on test was found to be 21·22 lb. per kw.-hour at full load; 23·423 lb. at three-quarter load; and 25·22 lb. at half load. From time to time tests have been made on the plant running under varying conditions, and the following results have been obtained.

The duration of the first test was 31 days. During 26 days the station was run without the battery, the direct-current machine being compounded, and during five days the station was run with the battery, the total output during the whole period being 196,448 units.

The second test also covered a period of 31 days, the total output being 195,510 units, and the plant being run for 26 days with the battery, and five days without the battery. The costs of operation under these two conditions were as follows:—

	Test (1) without battery. Cost per unit generated.	Test (2) with battery. Cost per unit generated.
Coal	·187d.	·147d.
Water	·032d.	·032d.
Oil	·029d.	·017d.
Waste	·003d.	·003d.
Stores	·009d.	·006d.
Wages	·220d.	·217d.
	·480d.	·422d.

The coal consumptions during these tests were:—

	Test 1.	Test 2.
Per unit generated	5·519 lb.	4·240 lb.
„ sold	6·678 „	5·324 „

When running with the battery, the units lost amounted to 39,810, whilst when running without the battery, the units unaccounted for were 36,467. The costs, therefore, per unit sold were ·592d. without the battery, and ·533d. with the battery, or a difference of ·059d. in favour of the battery, representing a total annual saving of £578 4s.

It might be contended that the necessity to run the two sets without the battery clearly indicates that the capital cost of the plant required for this supply could be reduced to the extent of one complete unit, and, of course, if this were so, the advantage to be derived from the installation of the battery would be absolutely and completely justified; but, as a matter of fact, this is not so. The one set could take care of the load under all conditions if the motor-generator had a larger capacity, but as it is, the motor-generator is incapable of overload, and although the single generating set is perfectly able to deal with the whole load, it is impracticable to operate the station in this way as the motor-generator is unable to deal with its portion of the load. If the capacity of the motor-generator were increased to 300 or 400 KW., then the one set could quite easily take the whole load under both conditions. In another station with which the author was associated, a 500-KW. set was regularly used to supply current for 50 cars.

During last month a further test was made for a period of five days, running without the battery, the coal consumed being 4·779 lb. per kilowatt-hour generated, and 5·262 lb. per kilowatt-hour accounted for; whilst the coal consumption for the six months ending December, 1905, and running in the ordinary way with the battery, was 4·257 lb. per kilowatt-hour generated and 5·101 lb. of coal per kilowatt-hour accounted for. These later tests are particularly interesting as showing the difference between the coal consumption per unit generated and sold under the two conditions. When working without the battery, the difference is ·483 lb., whilst when working with the battery the difference is ·844 lb.; that is to say, without the battery there was practically a 10 per cent. loss and with the battery, 20 per cent.; the result being that whilst there is a difference in coal consumption per unit generated of ·522 lb. per kilowatt-hour in favour of the battery, there is only a difference in the consumption per kilowatt accounted for of ·161 lb. per kilowatt-hour. The actual reduction in cost, therefore, under these conditions, is of the order of £55 per annum in favour of the battery.

It should be pointed out that owing to the relation between the size of the units and the load with which they have to cope, the conditions obtaining in this station are about as favourable as they possibly could be for the battery. As already explained, when using the battery, one set is practically fully loaded, whilst without the battery, the two sets are loaded only to an average of from one-third to one-half their rated capacity.

Let us now ascertain at what cost the reduction in the working costs due to the battery above enumerated is obtained. The following is a statement of the capital cost of the battery with its equipment of boosters, &c.

Battery	£3,546
56-KW. positive booster	729
40-KW. battery booster with Thury regulator ...	1,849
240-ampere milking booster	50
Switchgear	300
Buildings	750
Connections	50
Total	£7,274

The annual capital charges involved in connection with this equipment are as follows:—

Interest on cost of buildings, boosters, &c.	5 % on £3,728	£186 0
Depreciation on ditto	2½ % on £3,728	93 0
Interest and sinking fund on battery	6 % on £3,546	212 15
Maintenance (annual amount contracted for in tender)		236 0
		£727 15

representing a cost per unit of ·07d., whilst the reduction in cost due to that equipment under the best possible conditions is only ·059d. per unit, and on the later steam consumption tests only ·013d. per unit.

In the second case, a combined lighting and power station of 1,340 KW. capacity, the capital charges incurred through the provision of the battery amounted to ·096d. per unit, while the cost of fuel, water, and repairs amounted to ·37d. per unit. There was not the slightest reason to suppose that if the battery had not been installed the cost could have been so much higher (over 25 per cent.).

It would therefore appear that the conclusion, deduced from a general consideration of the matter, that the advantages to be gained by the installation of storage batteries, in tramway and power stations of even moderate size, are not justified by the cost at which they are obtained is well borne out by the actual results obtained under test.

Discussion.

The CHAIRMAN (Mr. S. L. Pearce) said there was a great divergence between the views expressed in the paper read by Mr. Brindle five years ago and those held by Mr. Salter. He thought, however, that the paper would induce engineers to look more closely into the question of the installation of storage batteries when designing stations.

Mr. MCKINNON contended that even four hours' cessation of running in 24 hours was of value for numerous reasons. The battery and booster in some stations took the early cars, and so gave a few more hours for overhauling, &c., if required, which might be very valuable. That the load factor was improved by the utilisation of storage batteries was demonstrated every day in actual practice. Battery makers would undertake to maintain a battery up to 100 per cent. of its capacity for periods of 10 or 20 years at a rate of about 6 per cent. on the original cost. Referring to the saving of copper in feeders by employing battery sub-stations, for a particular scheme it was found that by employing line batteries, there was a saving in first cost of 40 per cent. and a reduction in annual charges of 3 per cent. To constancy of pressure at the generating station should be added constant load on the generators, reducing wear and tear of plant and producing maximum economy in stoking and steaming. If the plant was large enough to deal with a fluctuating load, it must, during a considerable part of the time, be running at much below its most efficient load. If a station was crowded with surplus idle plant awaiting the demand which might or might not arise at some future date, the full advantage of a battery and booster would be lost, for the outstanding claim for a battery and reversible booster was that they took the place of one or more generators. It was quite fair to compare the cost of a battery with that of generating plant, if by installing one, and so giving a steady load to the remaining generators, additional generating plant was not required. Also, in computing the annual capital charges on a battery equipment, it was only reasonable to deduct the amount which would have been charged against the generator sets for which they had been substituted. From the figures it seemed that Mr. Salter paid £6,500 for a 475-KW. battery and a 40-KW. booster and accessories. This should not cost more than £5,000, even at the present high price of raw materials. In the United States no power plant was complete without its battery and booster. He could account for over 300 railroad installations put to work during the past six years on a rapidly increasing scale.

Mr. MILLER said that his experience of maintenance agreements was rather unfortunate; when the battery makers were receiving premiums it was all right, but as soon as anything went wrong with the battery, they pointed out that something had been done contrary to the regulations, and the agreement was void. Until battery makers were prepared to treat their customers in a reasonable way, they had no right to talk in the manner they did. He considered that batteries were very useful in small stations, up to, say, 40 cars; in that case, a battery and reversible booster were of great help. He mentioned a case where there were generally 30 cars running, supplied with power by one 100-KW. set with battery and reversible booster. If the latter were not in use, it would be necessary to run two 100-KW. sets. At busy times when more cars were running, they had to run two 100-KW. sets with the battery, the total output being 380 KW. In cases like that the installation of a battery and a reversible booster was of great assistance, and would reduce the amount of generating plant. He knew of an undertaking which purchased power in bulk from a supply company. The maximum demand was not to exceed 400 amperes. A battery and reversible booster was installed, and although 700 amperes were at times demanded, the stipulated rate of 400 amperes from the supply company's mains was not exceeded. He did not consider it fair to compare a battery on a lighting system with that on a traction system, as in the former case it was far more severely punished than in the latter.

Mr. C. D. TAITE said every case should be considered on its merits, and a battery must be put in suitable for the particular work in hand. In the author's case, the battery seemed to be blamed because the motor-generator was not of a sufficient capacity. He knew of stations where batteries on tramway systems were giving good results, and he proposed putting down in the near future a battery of considerable size, which would save the necessity of running a 750-KW. machine. On the other hand there were many cases, such as Manchester and Liverpool, where a battery would have very little effect at all. He had seen at the Mersey Railway power house, a battery discharging at 2,000 amperes at one moment, and the next moment receiving a charge; the generators could not possibly have taken the overload. The author did not

seem to be troubled with pressure variation, as evidently he had more than sufficient plant.

Mr. Jacobs mentioned a case where a battery was installed as standby, and in more than two instances it had been discharged at more than twice its rated one-hour capacity and had saved considerable trouble. He had had several years' experience of maintenance contracts, and in no case did he find that the makers failed to carry out their agreement.

Mr. S. J. Watson thought the adoption of storage batteries would effect a saving in generating plant. In the station of which he had charge, the units lost in the battery and booster for one year equalled 2¾ per cent. of the total units sold during the year.

Mr. Arthur said that taking the case of shut downs on a railway system, he did not think they lasted above an average of about 20 minutes. On a recent occasion at the generating station of the Liverpool and Southport Railway, owing to a misunderstanding on the part of the switchboard attendant, the whole of the sub-stations were cut out. The shut-down took about half-an-hour to remedy, but owing to the installation of the batteries at the sub-stations, they were able to continue the traffic, and no one knew that anything wrong had occurred in the power house. Batteries were a distinct advantage in cases of this kind. Before the installation of the batteries, three 1,500-kw. sets and one 750-kw. set had to be run, and the load was extremely variable. There were 14 trains running, and each train at starting took 2,000 amperes at 600 volts. It sometimes happened that nearly all the trains started together, which caused an overload on the station. This overload would be at one moment from 25 per cent. to 30 per cent., and the next moment no load at all. Since the installation of the batteries they had only needed to run two 1,500-kw. sets, and one 750-kw. set, being a saving of one 1,500-kw. set.

Mr. Salter, in replying, said he was disappointed that no speaker had brought any argument against his paper. He never said that batteries were of no use, but the question was whether the cost of installing them was justified by the results obtained. He agreed that batteries were of great advantage on railway systems, but there again, was their cost justified by the results obtained? The great overloads on the Liverpool and Southport line were due to the rapid rate of acceleration which the company decided on for their trains. Did this acceleration really save them three minutes on the whole journey, and did it pay them to have such a rapid rate at the expense of the batteries? Was it not possible to arrange to start and stop the trains at different times? One gentleman thought his station was not properly designed, and that there was too much plant. When the load came on that was anticipated when the station was built, the results would prove that the station was designed in a proper manner. He was aware that batteries could be maintained to give 100 per cent. efficiency for 10 years' service, but it was done by installing a battery of larger capacity than was actually required. If a battery was installed costing £3,000 the maintenance on it would probably be 10 per cent., whereas if it cost £6,000, the maintenance would be 5 per cent. The rate of maintenance varied with the size of the battery. Batteries in small lighting stations might be of very great use, but small lighting stations had no right to exist to-day, as there were plenty of power companies and municipalities read to supply them at a cheap rate.

Radiation of Electric Waves Mainly Confined to Certain Directions.

By G. Marconi, LL.D., D.Sc.

(*Abstract of note communicated to the* Royal Society *by Dr. J. A. Fleming, F.R.S. Received March 15th. Read March 22nd*, 1906.)

This note relates to results observed when for the usual vertical antenna employed as radiator or absorber in wireless telegraph stations, there is substituted a straight horizontal conductor placed at a comparatively small distance above the surface of the ground or water.

When an insulated horizontal wire A B, such as is shown in fig. 1, is connected at one end to a sphere of a spark gap, the other sphere of which is earthed, and sparks are caused to pass between the spheres, it will be noticed on investigating the space around such an oscillator that the radiations emitted reach a maximum in the

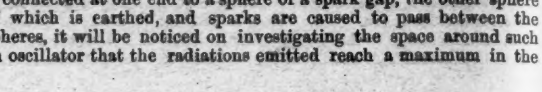


Fig. 1.

vertical plane of the horizontal wire A B, and proceed principally from the end A, which is connected to the spark gap, whilst the radiation is *nil*, or reaches a minimum, in directions which are approximately 100° from the direction in which the maximum effect occurs.

I have also noticed that any horizontal conductor of sufficient length placed upon or at a short distance above the surface of the ground, and connected at one end through a suitable detector to earth, will receive with maximum efficiency only when the transmitter is situated in the vertical plane of the said horizontal receiving conductor and in such a direction that the end connected to the detector and to the ground is pointing towards the transmitting station.*

If, therefore, such a horizontal conductor be swivelled about its earthed end in a horizontal plane, the bearing or direction of any transmitting station within range of the receiver can be ascertained.

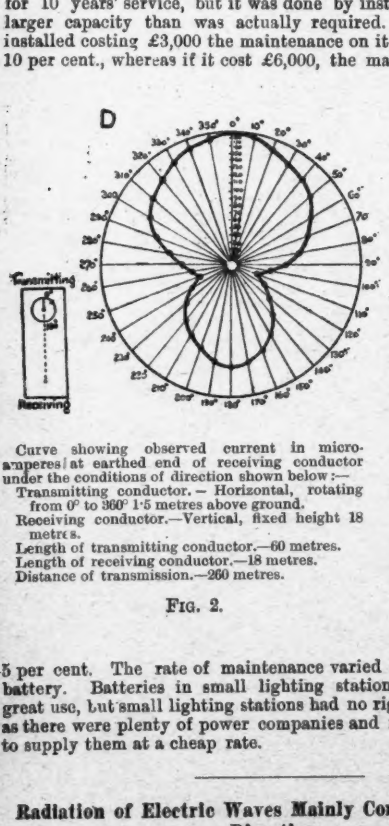
I have carried out a number of tests with transmitters and receivers having radiating or receiving antennæ or conductors arranged as follows:—

1. Transmitting conductors consisting of horizontal wires, the radiations being received at a distance by means of the usual vertical wires suitably attuned.

2. Both transmitting and receiving conductors consisting of horizontal wires.

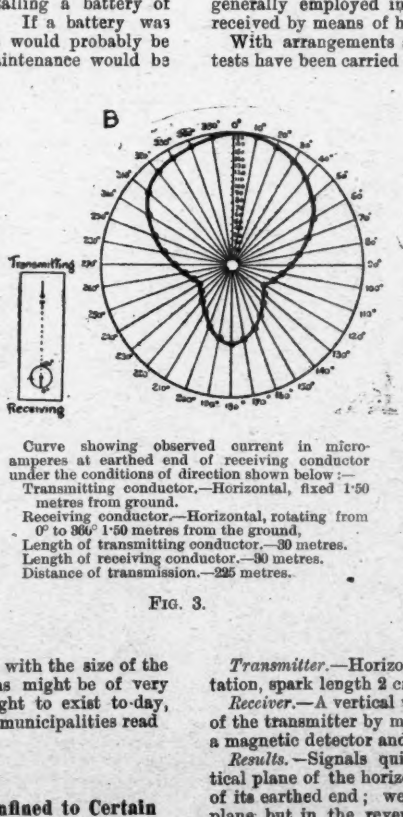
3. Transmitting conductors consisting of one or more vertical wires with or without capacity areas at the top, such as have been generally employed in wireless telegraphy, the radiations being received by means of horizontal conductors.

With arrangements such as are referred to in (1), the following tests have been carried out:—



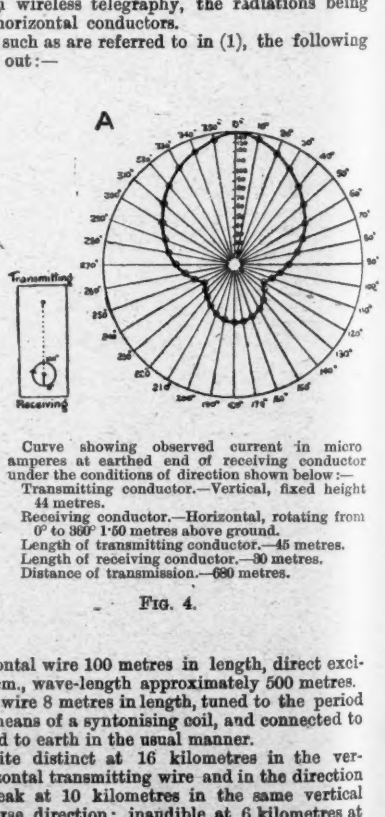
Curve showing observed current in micro-amperes at earthed end of receiving conductor under the conditions of direction shown below:—
Transmitting conductor.—Horizontal, rotating from 0° to 360° 1·5 metres above ground.
Receiving conductor.—Vertical, fixed height 18 metres.
Length of transmitting conductor.—60 metres.
Length of receiving conductor.—18 metres.
Distance of transmission.—260 metres.

Fig. 2.



Curve showing observed current in micro-amperes at earthed end of receiving conductor under the conditions of direction shown below:—
Transmitting conductor.—Horizontal, fixed 1·50 metres from ground.
Receiving conductor.—Horizontal, rotating from 0° to 360° 1·50 metres from the ground,
Length of transmitting conductor.—30 metres.
Length of receiving conductor.—30 metres.
Distance of transmission.—225 metres.

Fig. 3.



Curve showing observed current in micro amperes at earthed end of receiving conductor under the conditions of direction shown below:—
Transmitting conductor.—Vertical, fixed height 44 metres.
Receiving conductor.—Horizontal, rotating from 0° to 360° 1·50 metres above ground.
Length of transmitting conductor.—45 metres.
Length of receiving conductor.—30 metres.
Distance of transmission.—680 metres.

Fig. 4.

Transmitter.—Horizontal wire 100 metres in length, direct excitation, spark length 2 cm., wave-length approximately 500 metres.

Receiver.—A vertical wire 8 metres in length, tuned to the period of the transmitter by means of a syntonising coil, and connected to a magnetic detector and to earth in the usual manner.

Results.—Signals quite distinct at 16 kilometres in the vertical plane of the horizontal transmitting wire and in the direction of its earthed end; weak at 10 kilometres in the same vertical plane, but in the reverse direction; inaudible at 6 kilometres at right angles to the directions above mentioned.

Polar diagram D gives the values of the received current in micro-amperes, with conditions as marked under the diagram.

With the arrangement mentioned at (2), *i.e.*, both transmitting and receiving conductors horizontal, the results over short distances are shown in polar diagram B.

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* See British Patent Specification No. 14,788, July 18th, 1905.

With arrangements such as are mentioned at (3), *i.e.*, the transmitting conductor consisting of the usual vertical type and the receiving conductor horizontal . . . the following results among others merit attention:—

At Clifden, Connemara, Ireland, by means of a horizontal conductor 230 metres in length, laid on the ground and connected at one end to a magnetic receiver and to earth, it is possible to receive with clearness and distinctness all the signals transmitted from the Poldhu station (situated 500 kilometres distant) provided that the free end of the said conductor points directly away from the direction of Poldhu. No signals can be received if the horizontal wire at Clifden makes an angle of more than 35° with the line of direction of Poldhu.

The signals from the Admiralty station at Scilly can be received at Mullion, Cornwall (distance about 85 kilometres), by means of a horizontal wire 50 metres in length, 2 metres above ground, provided said wire is placed in a radial position with regard to the sending station and with its free end pointing away from it. But it is unreceptive if placed so as to make an angle of more than 20° with the line of direction of the station at Scilly.

Some tests have also been carried out for the Admiralty in the vicinity of Poldhu in conjunction with H.M.S. *Furious*. For this purpose eight horizontal wires 60 metres in length, supported at a height of about 2 metres, were arranged radially and made to converge in a small building situated in a field near Poldhu. These radial wires were so arranged as to divide the circle into eight equal sectors. By means of a suitable switch any one of the ends of these wires at the position were they converged together could be connected to earth through a magnetic receiver.

The wireless telegraph station on H.M.S. *Furious* consisted of an ordinary vertical wire aerial about 50 metres in length, connected to a suitable spark gap. The station on the ship transmitted at intervals, and the ship followed a course describing an arc of about 180° round Poldhu, keeping at distances varying up to 16 miles.

By means of the horizontal wire arrangement, the bearing of the ship from Poldhu could be determined at any time by noting on which particular wire or wires the reception of signals was strongest, and also by observing which wires were non-receptive.

It was also found possible to receive simultaneously and without mutual interferences different messages sent by means of oscillations of the same wave-length coming from the ship and from the Lizard wireless station (10 kilometres away), whenever the ship was in such a position that its bearing from Poldhu made an angle of at least 50° with the bearing of the Lizard station.

For further values and curves of received current in receivers, I refer to diagram A.

Referring generally to the results mentioned in this note, I have observed that, in order that the effects should be well marked, it is necessary that the length of the horizontal conductors should be great in proportion to their height above the ground, and that the wave-lengths employed should be considerable.

I have found the results to be well marked for wave-lengths of 150 metres and over, but have not been able to obtain as well-defined results when employing much shorter waves—the effects following some law which I have not yet had time to investigate. There also appears to be a decided advantage in so far as effects at long distances are concerned in utilising a directly excited radiating conductor—that is, an insulated conductor in which the high frequency oscillations are started by means of a suitable spark discharging it to earth or to another body, as was usual in my early forms of Hertzian-wave wireless telegraph transmitters.

I have noticed that the most advantageous length of the receiving horizontal wires, in order to obtain results at maximum distances, is about one-fifth of the length of the transmitted wave, if said wires are placed at a distance above the ground; but the receiving wires should be shorter if placed on the ground.

When using horizontal receiving wires arranged as described in this note, I have often noticed that the natural electrical perturbations of the atmosphere or stray electric waves, which are generally prevalent during the summer, appear to proceed from certain definite directions which vary from time to time.

It would be exceedingly interesting to investigate whether there exists any relation between the direction of origin of these waves and the known bearing or direction of distant terrestrial or celestial storms from whence the stray electric waves most probably originate. A considerable number of observations would be necessary to determine whether there exists any relation between the bearing of the terrestrial storm centres and the direction of origin of these natural electric waves. I propose to carry out some further investigations on the subject.

The tests over short distances were carried out over practically flat country, whilst those over considerable distances took place over hilly country, such as the West of England, and in some cases partly across sea and land.

Tramcar Equipment.

By P. Hunter-Brown.

(*Abstract of Paper read before the* Nottingham Guild of Mechanical and Electrical Engineers.)

The secret of success in designing a motor for this class of work lies in paying infinite attention to even the most minute details, always provided of course that the fundamental basis is sound. Nothing but a combination of the best material, the best design, and the best workmanship can hope to survive the perpetual jolting and vibration, not to mention ill-usage by unskilful drivers, that a traction motor has to endure.

The routine tests applied to every Brush traction motor on completion are as follows:—One hour's run at the rated full load; measurements are taken of speed, resistance, insulation, and temperature rise. The motor is further tested by an application of 2,000 volts between the windings and iron for 10 minutes. A pressure test that is frequently specified by consulting engineers is 3,000 volts for 5 or 10 seconds. The wisdom of this is certainly open to criticism. A very high voltage is liable permanently to strain and injure the insulation, although it may not at the moment cause a breakdown. Also a motor may stand 3,000 volts for 10 seconds, and yet break down at 2,000 volts for 10 minutes.

In addition to these, special temperature and efficiency tests are made on a few of the motors to furnish the data required for a complete study of their performance.

To obtain high efficiency is important, because high efficiency means a low loss, and it is the loss that heats the motor. In starting, a certain quantity of energy must be wasted in the rheostats, but the amount of waste varies inversely as the skill of the motorman. The accelerating current should be kept as nearly uniform as possible. In other words, the resistance should be cut out as quickly as possible provided the maximum permissible current is not exceeded.

The energy expended in stopping a 12-ton car running at 10 miles per hour amounts to 90,000 ft.-lb., and this is sufficient to carry a passenger 9 miles. Thus, it costs as much to stop the car for a single passenger to get in as it does to carry him 9 miles on the level. This shows what careful consideration should be given to ascertaining the most efficient number of stopping places.

The rated horse-power of a traction motor is that H.P. which it can give for one hour continuously, without the temperature rise exceeding a certain figure. This method of rating a motor leaves much to be desired. For instance, the Brush Co.'s 1,002D, 1,002A, 1,002B are rated at 24, 27 and 31 H.P. respectively, although they all weigh the same and cost the same; yet in many cases the engineer would be money in pocket by selecting the 1,002D, in spite of the temptation to get the maximum H.P. possible for his money. To designate the motors by the tractive effort they are capable of giving for one hour would be no improvement; in fact, it would be worse, for the output of all the above three motors would then be the same, viz., 1,200 lb. Horse-power may be looked upon as the product of pull and speed. To know, then, merely the product of pull and speed is almost useless; we must know one of the factors as well, before we have any useful information at our disposal. Would it not be more convenient to designate a motor by its tractive effort and speed, or by H.P. and speed in miles per hour, with the standard gear reduction of 4·78 and 30-in. wheels? The rated outputs of the three motors instanced would then be $\frac{24}{7\frac{1}{2}}$, $\frac{27}{8\frac{1}{2}}$ and $\frac{31}{9\frac{1}{2}}$, the numerator giving horse-power, and the denominator miles per hour. It will be noticed that the horse-power varies in proportion to the speed, and this explains at once that the lower rated motors are simply the same carcasses for lower speeds.

It is most difficult to arrive at the correct total horse-power with which a given car should be equipped for a given line.

The first question to decide is whether the car should have one, two or four motors. In the case of light cars running with infrequent stops on a clear, level line, a single motor will give excellent results. The controller and wiring will be simpler and cheaper; the first cost and weight of, say, one 30-H.P. motor will be less than those of two 15-H.P. motors, and the efficiency of the larger motor will be higher. The saving of weight of motors will probably reduce the weight of the truck also to a certain extent, so that altogether there is an appreciable saving in current due to the car being lighter. The chief disadvantage is that, in the event of a breakdown to the motor, the car is completely crippled.

The uneconomical variation of speed in a single-motor equipment renders its sphere of usefulness very limited, and for street work generally this is an insurmountable objection. The majority of single-truck cars will then be fitted with two motors. By means of series-parallel control the amount of current at starting is halved, and, what is more important, two economical speeds are available. Moreover, in the event of the breakdown of one motor the car may be run home on the remaining motor.

In the case of large cars with double trucks we have to decide whether it is best to equip all four axles with motors, or two only. The first cost of four, say, 20-H.P. motors will be higher than that of two 40-H.P. motors, and in addition the controller and wiring will be more expensive. On the question of maintenance cost, it is difficult to get conclusive evidence, but the repair bill is likely to be about 20 per cent. more with the four motors.

On a stiffly graded route with a two-motor four-axle car considerable difficulty is experienced in obtaining sufficient adhesion, even though maximum traction trucks be used. Even if actual slipping does not occur, the acceleration will be very poor; rapid acceleration is a matter of the utmost importance, and has the additional advantage that, though the current is larger, yet the total energy consumed is less than with slow acceleration. Given then a route with heavy grades and frequent stops, a four-motor equipment will be more economical and give a more reliable service than a two-motor equipment. Each case must be carefully considered on its own merits, however, and unless there is good reason for putting in four motors, two only should be used.

Electric tramways are exceedingly expensive, both to install and to run, and can only be made to pay in fairly populous districts. If small towns are to enjoy the same advantages as large ones, it will be necessary to devise some means of cheapening them.

Now the whole capital cost of a tramway undertaking practically depends upon the weight of car per passenger. Reduce this and

the saving effected is reflected right back from the car through the track, the cables and the generating plant to the boilers, to say nothing of the reduction in running expenses as well. The problem then is to reduce the weight of car per passenger.

It is the universal practice in this country to use totally-enclosed motors, but prolonged tests have been made in the States with ventilated motors, and have shown that the motors can be reduced about 25 per cent. in weight, and that they then keep cooler than the displaced totally-enclosed ones. They have, moreover, been in successful operation in summer and winter, through dust, snow and rain.

Another way to reduce weight is to adopt worm gearing instead of spur gearing, which permits the use of a very much higher motor speed.*

By ventilation and increased revolutions per minute, it should be possible to reduce the weight of the motors to about one-half their present weight. Even if made totally enclosed, a high-speed worm-geared motor could be much more effectively cooled than the motors at present in use, because with the extra room available, the case could be ribbed to present a large radiating surface. With the two motors weighing considerably less than ½ ton each, the body and truck could be made much lighter, so that the 50-passenger car complete would not weigh more than about 6 tons.

NEW PATENTS APPLIED FOR.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

9,446. "An improved mounting device for securing the glass bulbs of incandescent electric lamps to their caps." J. Robertson. April 23rd.

9,488. "Improvements in rotating field magnets of electric machines." Siemens Bros. & Co., Ltd. (Siemens-Schuckertwerke, G.m.b.H., Germany.) April 3rd. (Complete.)

9,504. "Improvements connected with the underground conduit system for electric traction." A. A. Jordan. April 23rd.

9,509. "Improvements in connection with electrically operated valves." Elektrizitäts Act.-Ges. vorm W. Lahmeyer & Co. (Date applied for under Patents Act, 1901, May 3rd, 1905, being date of application in Germany.) April 23rd. (Complete.)

9,544. "Improvements in motor control systems." The British Thomson-Houston Co., Ltd. (General Electric Co., United States.) April 24th.

9,550. "An improved electric controller contact." W. McCormick. April 24th.

9,556. "Automatic block signal system for electric railways." G. W. Johnston and A. H. Ackermann. (Date applied for under Patents Act, 1901, April 25th, 1905, being date of application in United States.) April 24th. (Complete.)

9,583. "Improvements in selective telephones." N. S. McKinsey. April 24th. (Complete.)

9,594. "Improvements in electro-pneumatic channelers." H. H. Lake. (Ingersoll-Rand Co., United States.) April 24th. (Complete.)

9,606. "Improvements in rotary converters." J. L. Murdock. April 24th.

9,612. "Improvements in electric hammers." W. F. Wegner and A. Wendleburg. April 24th. (Complete.)

9,630. "Improvements in electrical devices for simultaneously actuating the controllers of several railway vehicles from any one of these vehicles." Compagnie de L'Industrie Electrique et Mecanique. (Date applied for under Patents Act, 1901, April 25th, 1905, being date of application in Germany.) April 24th. (Complete.)

9,633. "Improvements in and relating to dynamo-electric machines." The British Thomson-Houston Co., Ltd. (General Electric Co., United States.) April 24th.

9,688. "Improvement in alternating current motors." C. E. L. Brown. April 25th. (Complete.)

9,693. "Improvements in and relating to horizontal electric arc lamps." Crompton & Co., Ltd., and C. F. Tubbs. April 25th.

9,706. "Improvements in electrolytic apparatus." G. J. Atkins. April 25th.

9,763. "Improved combined electric switch and lampholder." F. R. Connell. April 26th.

9,772. "An improvement in electric glow lamps." Siemens & Halske Akt.-Ges. (Date applied for under Patents Act, 1901, May 31st, 1905, being date of application in Germany.) April 26th. (Complete.)

9,781. "Improvements in space telegraphy." J. S. Stone. (Date applied for under Patents Act, 1901, June 20th, 1905, being date of application in United States.) April 26th. (Complete.)

9,784. "Improvements in and relating to electric arc lamps." E. R. Grote and M. V. Ely. April 26th.

9,786. "An improved method of electrical detection between railway or tramway signals, points, facing point locks or fouling bars." McKenzie and Holland, Ltd., and C. H. W. Edmonds. April 26th.

9,788. "Improvements in space telephony." J. S. Stone. (Date applied for under Patents Act, 1901, June 20th, 1905, being date of application in United States.) April 26th. (Complete.)

9,789. "Improvements in electric fusible cut-outs." O. L. Peard. April 26th.

9,792. "Improvements relating to electric ignition devices for internal combustion engines." T. H. Gardner and E. Gardner. April 26th.

9,794. "Improvements in brushes for dynamo-electric machinery." The Morgan Crucible Co., Ltd., and C. W. Speirs. April 26th.

9,846. "Improvements in alternating current electric traction systems." Siemens-Schuckertwerke G.m.b.H. (Date applied for under Patents Act, 1901, June 16th, 1905, being date of application in Germany.) April 27th. (Complete.)

9,858. "Improvements in alternating current commutator motors." H. C. E. Jacoby. April 27th.

9,859. "Improvements in motor starting and regulation switches for organ blowing, pumping up water reservoirs and similar devices." H. C. E. Jacoby. April 27th.

9,884. "Improvements in current distributing devices for effecting the ignition in explosion engines." H. de la Valette. April 27th.

9,904. "Improved electric motor mechanism for automobiles." A. Weiss. Date applied for under Patents Act, 1901, January 16th, 1906, being date of application in Germany.) April 27th. (Complete.)

9,915. "Improvements in means for operating the switches, frogs and signals of electric tramways." L. Atkinson. April 27th. (Complete.)

9,916. "Vacuum tube electric apparatus." W. L. Wise. (The Moore Electrical Co., United States.) April 27th. (Complete.)

9,921. "An improved electric controller for organ blowing and the like." J. G. Booth, P. S. Brook and J. A. Hirst. April 28th.

9,926. "An appliance for enabling electric switches to be worked from any direction or place." V. Brew-Mulhallen. April 28th.

9,951. "Improvement in electro-automatic mechanism for displaying advertisements." W. B. Johnson. (F. de Blanco y Perez de Vara, Spain.) April 28th. (Complete.)

9,958. "Improved means for deadening noise in electric conductors." H. G. Godwin. April 28th.

9,959. "Improvements relating to the deposition of metals or metallic compounds upon, and their combination with, metals or metallic articles." F. W. Gauntlett. April 28th.

9,980. "Improvements in metallic vapour electric lamps." C. A. Lee. April 28th.

9,990. "An improvement in electric mercury vapour lamps." Siemens-Schuckertwerke G.m.b.H. (Date applied for under Patents Act, 1901, May 31st, 1905, being date of application in Germany.) April 28th. (Complete.)

* See Electrical Review, October 21st, 1903, p. 644.

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1904.

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1905.

Chains for Use in Supporting or Ornamenting Electroliers and other Purposes. J. Dugmore. 20,681. October 12th.

Method and Means for Insulating the Sparking Plugs of Internal Combustion Engines. J. Kritzler. 21,643. October 24th.

Electric Motors. H. H. Lake. (International Holding Co.) 21,652. October 24th.

Electric Propulsion of Vehicles. Krieger and Cie. Parisienne des Voitures Electriques. (Procedes Krieger.) 25,173. December 4th. (Date applied for under International Convention, May 30th, 1905.)

Receiving Apparatus for Explosive Submarine and Land Mines Operated by Electric Waves. F. Schneider. 25,383. December 6th. (Date applied for under International Convention, January 23rd, 1905.)

Apparatus for Storing and Paying Out Lengths of Conductors or Wires Connected to Electric Instruments or Apparatus. R. J. F. S. Baron. 26,052. December 14th.

Method and Means of Converting and/or Transforming Continuous Currents of Electr city. R. Grisson. 6,807. March 24th.

Substances for Effecting Catalytic Combinations in Electrolytic Electricity Meters. C. O. Bastian and G. Calvert. 6,448. March 27th.

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Means for Electrically Maintaining and Reproducing Recurring Movements Particularly Applicable to Clock Movements and Time Transmission. R. M. Lowne and the Lowne Electric Clock and Appliances Co. 6,690. March 29th.

Dynamo-Electric Machines of the "Homopolar" or "Acyclic" Type. J. E. Noeggerath. 6,752. March 30th. (Date applied for under International Convention, March 30th, 1904.)

Plates for Accumulators or Secondary Batteries. F. J. Gerard and L. Fiedler. 6,786. March 30th.

Method of Wiring or Connecting Electric Conductors and Mounts or Supports and the like Therefor. H. Bailey. 6,867. March 31st.

Electric Furnaces. A. Reynolds. 7,004. April 3rd.

Electrically Controlled Device for Operating Valves of Internal Combustion Engines. J. A. Main. 7,075. April 4th.

Telegraphic Systems and Apparatus Therefor. W. P. Phillips. 7,841. April 12th.

Regulation of the Voltage of Alternating Electric Current Systems and Apparatus Therefor. British Thomson-Houston Co., Ltd. (General Electric Co.) 8,215. April 18th.

Electrical Collector Trolley Head. R. Baron. 8,846. April 27th.

Electric Switch Apparatus. A. F. Berry. 8,927. April 27th.

Electric Train Lighting Systems. W. L. Bliss. 8,929. April 27th. (Date applied for under International Convention, April 27th, 1904.)

Electro-Magnetic Annunciators Acting Simultaneously as Choking Coils. H. Oppenheimer. (Akt. Ges. Mix and Genest.) 14,457. July 13th.

Low Tension Electric Ignition Mechanism for Internal Combustion Motors. J. S. Critchley. 14,582. July 15th.

Step-by-Step Electric Switches. H. G. White and I. B. Birnbaum. 17,957A. (Date applied for under Rule 5 of Patents Rules 1905, December 13th, 1905.)

Microphones or Telephone Transmitters. E. Treyer. 18,193. September 8th. (Date applied for under International Convention, February 15th, 1905.)

Process for the Production of Incandescence Filaments for Electric Incandescence Lamps. The Deutsche Gasgluhlicht Akt.-Ges. Auergesellschaft. 19,379. September 25th. (Date applied for under International Convention, January 17th, 1905.)

Electric Elevator or Lift Control Systems. Otis Elevator Co. (Otis Elevator Co.) 20,951. October 16th.

Coil Trembler for Electrical Ignition Apparatus of High Speed Engines for Motor Cars and Similar Vehicles. S. J. Williams. 21,521. October 23rd.

Electro-Magnetic Power Hammer, Drop Stamp, or Press. T. H. Large. 23,075. November 10th.

Electric Switches for the Control Circuits of Electro-Magnetic Power Hammers, Drop Stamps, Presses, and the like. T. H. Large. 24,187. November 23rd.

Devices for Electrically Lighting Inverted Gas Burners. P. Benard. 24,200. November 23rd. (Date applied for under International Convention, November 26th, 1904.)

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Thermo-Electric Galvanometers. C. Fery. 26,691. December 21st. (Date applied for under International Convention, January 6th, 1905.)